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Forest Health Assessment and Biological Evaluation of Fort Necessity National Battlefield

Forest Service

Northeastern Area
State and Private Forestry

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Forest Health Assessment and Biological Evaluation of Fort Necessity National Battlefield

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FORWARD

This document addresses the forest health concerns of Fort Necessity National Battlefield. Communication and cooperation have been fostered through development of a coordinated Forest Health Biological Evaluation of the Park's resources. This has resulted in strengthened partnerships between the National Park Service and the U.S. Forest Service. It is hoped that this Forest Health Assessment and Biological Evaluation will guide management, and develop and increase the management efficiency of forest health issues should they arise at the Park over the next 10 to 15 years. This document focuses on evaluating the current forest resources in the Park, identifying potential pests of concern, and making management recommendations to protect and enhance all resources.

ACKNOWLEDGEMENTS

We would like to thank the following people for their time and assistance with this report. Mary Ellen Snyder of the National Park Service contributed her time by assisting us on several field visits in all three units of the Park. Her local knowledge of past and future projects at Fort Necessity was instrumental in helping develop a forest health management strategy. Her contributions and support are greatly appreciated. We also thank Stephanie Perles and Doug Manning of the National Park Service for meeting and providing us with documentation to describe the vegetation communities and conditions at Fort Necessity. Without their expertise and inventory information, this Forest Health Assessment and Biological Evaluation would not have been possible.

EXECUTIVE SUMMARY

Fort Necessity National Battlefield (FONE) and its associated units were examined during October and November 2016, and in May 2017. The purpose was to determine forest types; assess forest health; identify existing and future insect, disease, and invasive issues; and prepare a document that will assist the National Park Service (NPS) in making management decisions.

Documents compiled by the NPS Northeast Region (Perles et al. 2006; Perles et al. 2010, and Perles et al. 2014) provided valuable information on forest types, vegetation communities, vegetation classification, and nonnative plant species, which was ground truthed during visits to FONE and its other units. These technical and natural resource reports provided biological data to address natural resource management issues and were used as a basis for the Forest Service investigation of the FONE units.

Management recommendations and alternative strategies, consistent with NPS objectives, are provided here to protect or enhance all resources that are present. Some prescriptions, treatments, or recommendations are site specific.

To efficiently allocate resources to the overwhelming threat of invasive species it is recommended the Park adopt an approach to invasive species management to order to efficiently allocate resources to this overwhelming threat.

- Choose biologically/culturally important sections of the park (typically small areas) to remove most invasive species and maintain them as invasive-free.
- Enlist Park personnel in early detection of new invasive species, as well as rapid response to eliminate newly-established populations of these species. The time of initial invasion is the most cost-effective time to manage a species. The Eastern Rivers and Mountain Network (ERMN) can provide information on the FONE early detection-rapid response program.
- Dedicate resources to and cultivate partnerships that bring biological controls to the Park for well-established abundant species that cannot be otherwise controlled park-wide.
- Specific treatments for most invasive plant species are found in the Forest Health Section of this document.
- All equipment used in these treatments should be thoroughly cleaned before entering Park property to avoid introducing additional invasive species. https://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2010.pdf

Wildfire can be both destructive and beneficial. The usual response to wildfire is to extinguish it before it destroys woodlands, vegetation, and structures. After many years of fire exclusion, an ecosystem that needs periodic fire becomes unhealthy. Trees are stressed by overcrowding; fire-dependent species disappear; and flammable fuels build up and become hazardous. Sometimes the right fire needs to be at the right place at the right time to reduce hazardous fuels; minimize the spread of pest insects and disease; remove unwanted species that threaten species native to an ecosystem; and promote the growth of trees, wildflowers, and other plants.

If a decision is made to allow wildfire to burn sections of the Park for the purposes of restoring oak and other ecosystems, contact the Bureau of Forestry and request a fire map for the Park's vegetation that shows the areas of the Park that would likely benefit from fire, and the areas from which fire should be immediately suppressed. Use this map to determine fire containment boundaries to best manage the forests within the Park.

To remain healthy forests need to be managed.. A healthy forest is a diverse mix of young and old trees, dead trees, and openings. Without management, these forests will remain prone to high-intensity wildfires and increased damage from forest pests. It was observed that the forests appear healthy through the FONE Main Unit, Braddock's Grave and Jumonville Glen, but in some cases they are mature or over mature, which means they will begin to decline over time. Managing the forests of FONE for their sustainability should be a priority. It's recommended to consult the Pennsylvania Bureau of Forestry for the development of a forest management plan for the Park.

FONE Main Unit

Immediate Action:

- Treat or remove Japanese stiltgrass from the old water tower road and mowed trails in the Rush Tract. Treatment with herbicides or mowing needs to be done in August or early September before the seed sets.
- Remove honeysuckles and other invasive species from the perimeters of the access roads.
- Remove all Colorado blue spruce that are exhibiting the *Cytospora* canker disease.
- In the hemlock area adjacent to the parking lot in the visitor's area, underplant with red or white spruce or white pine. If white pine are planted they will need to be protected from white-tailed deer with fencing until they are tall enough to be out of the reach of deer. Underplanting the hemlock will allow trees time to become established if/after hemlock succumb to hemlock wooly adelgid (HWA) infestations.
- Continue invasive plant control in the woodcock management area.
- Determine whether Morrow's honeysuckle control was effective at the main entrance, and continue treatments if populations have returned.
- Control Japanese barberry in high use visitor areas since it has been implicated in the spread of Lyme disease.

Yearly Actions:

- Monitor for hemlock woolly adelgid and gypsy moth, to identify emerging forest health threats and provide for a rapid evaluation and response. Contact the Forest Service Office in Morgantown, WV for assistance if crown dieback or defoliation is detected.
- The impacts of possible treatments on native Lepidoptera species (especially the rare state-listed species) known to occur within the Park should be considered in determining the appropriate response to gypsy moth.
- In areas that do not have high visitor use, the Park should consider leaving dead or dying trees as wildlife habitat and forest structure components.
- Monitor grassed roads, parking perimeters, and trails for invasive plants.
- Practice the Firewise method around the facilities by removing burnable materials from around the structures.
- Contact the Forbes State Forest District Office representative and request that a Bureau of Forestry representative visit FONE to provide Firewise advice.
- Monitor the forested areas for any buildup of forest fuels on the forest floor in areas that may be prone to wildfire danger.

2-10 years:

- Consult with the Pennsylvania Bureau of Forestry if the decision is made to manage the forests of all three FONE units. Request a comprehensive forest management plan.

- Plant old fields to native tree species and protect the plantings with tree tubes or other protective devices to minimize injury from maintenance or wildlife browsing.
- Set aside one or two fields for pollinator habitat and use recommended seed mixes.

Mt. Washington Tavern

Immediate action:

- Remove the ash, red maple, and all other dead or dying trees and shrubs that were planted in the grassy areas along Route 40 and around the parking area. The ash and red maple pose a threat to public safety, and should take priority.
- Treat the Japanese knotweed around the parking areas.
- Treat or remove the invasive plants in the wooded area between the Tavern and the Meadow.
- All trees and shrubs which are showing signs of injury should be removed and replaced with native species either by fall 2017 or spring 2018.
- Tree tubes or other protection devices and mulch needs to be installed around the trees and shrubs to prevent injury from mowing, weed eaters, and browsing by wildlife.
- Maintenance contractors or Park staff need to be advised how to protect planted materials at the Tavern and elsewhere in the Park.

Yearly Action:

- Monitor grassed roads, parking perimeters, and trails for invasive plants. Treat them if found.

Action in 2-5 years:

- Consider removing one or two of the Norway spruce from the group of four only if any of the trees show signs of dying. At this time they are healthy, but repeated mowing damage to the surface roots could weaken the trees making them susceptible to diseases or insect attack.
- Consider removing the Colorado blue spruce behind the Tavern. It is showing signs of stress due to a canker disease. Some of the lower branches are dead and dying.
- Consider removing the hickory, which is on the left side the Tavern. It did not have a full set of leaves during the spring and summer of 2017 and is in process of dying.
- Contact Morgantown Field Office specialists to investigate the tree mortality in the wooded area below the parking lot.

Braddock's Grave

Immediate Action:

- Treat or remove the Morrow's honeysuckle and other invasive plants, if found, around the perimeter of the parking area and the monument.
- Treat and remove the multiflora rose and barberry at the original grave site by Braddock's Run.
- Remove garlic mustard from the area around the monument. Plants were observed around the second stairway from the parking area.

Yearly Actions:

- Because there is a high oak component in this woodland section of this unit, it will be susceptible to gypsy moth defoliation in the future. The oldest oaks may succumb after one gypsy moth defoliation. Contact the Forest Service Office in Morgantown, WV for assistance if crown dieback or defoliation is detected.
- Monitor for hemlock woolly adelgid.

- The impacts of possible gypsy moth treatments on native Lepidoptera species (especially the rare state-listed species) known to occur within the Park should be considered in determining the appropriate response to gypsy moth.
- In areas that do not have high visitor use, the Park should consider leaving dead or dying trees as wildlife habitat and forest structure components.
- Monitor the parking perimeters and walkways for invasive plants.
- Monitor the forested areas for any buildup of forest fuels on the forest floor in areas that may be prone to wildfire danger.

Jumonville Glen

Immediate Action:

- Treat the Japanese knotweed around the parking area.
- Treat the autumn olive and barberry at the end of the old access road.
- Remove the dying black cherry, which is behind the restrooms.
- Remove the dying trees from the island in the parking area.

Yearly Actions:

- Because gypsy moth egg masses were found at this site, monitor for gypsy moth to identify emerging forest health threats and provide for a rapid evaluation and response.
- Contact the Forest Service Office in Morgantown, WV for assistance if crown dieback or defoliation is detected.
- The impacts of possible treatments on native Lepidoptera species, especially the rare state-listed species known to occur within the Park, should be considered in determining the appropriate response to gypsy moth.
- In areas that do not have high visitor use, the Park should consider leaving dead or dying trees as wildlife habitat and forest structure components.
- Monitor grassed roads, parking perimeters, and trails for invasive plants.
- Monitor the forested areas for any buildup of forest fuels on the forest floor in areas that may be prone to wildfire danger.

LANDOWNER OBJECTIVES

Landowner: National Park Service, 1 Washington Parkway, Farmington, PA 15437 (724) 329–5512

Purpose of the Fort Necessity National Battlefield as stated in the Fort Necessity Foundation Document (USDI 2013):

> "Fort Necessity National Battlefield preserves the sites of the opening battles of the French and Indian War and commemorates George Washington's early military career and the global consequences of the conflict."

The Fort Necessity National Battlefield and its other land units are significant historical sites for the opening actions of the French and Indian War and set the stage for the American Revolution. NPS managers are responsible for conserving the historical values of the Park and interpreting its significance for visitors.

The NPS is interested in a biological assessment of the resources within the Park's units and recommendations the Forest Service can provide to maintain the health of the forests and other resources within those units. The NPS recognizes there are problems with invasive plants throughout the Main Unit of the Park and has taken steps to control some sites.

Summary of Landowner Objectives: Historical conservation, forest health with emphasis on invasive plants, and conservation of threatened and endangered species.

LOCATION AND REGIONAL SETTING

FONE comprises approximately 900 acres in three separate sites. The Main Unit of FONE is located in Fayette County, about 11 miles east of Uniontown, PA, on US Route 40, the historic National Road. Fayette County is in the Allegheny Mountains of the Appalachian Plateau physiographic province. It features broad, rounded ridges separated by broad valleys. The ridges decrease in elevation from south to north and the ridges have no topographic expression at the north end of the section. The ridges occur on the crests of anticlines that have been eroded enough to expose the very resistant rocks that form the crests of the ridges (Shultz 1999). The southern parts of these ridges form the highest mountains in Pennsylvania. The valleys are broad, undulating surfaces with shallow to deep stream incision. Relief between the ridge crests and the adjacent valley lowland can be greater than 1,000 feet. Local relief on the broad valley lowland is generally less than 500 feet.

The area is also known as the Laurel Highlands, a region in southwestern Pennsylvania made up of Cambria, Fayette, Somerset, and Westmoreland Counties. The Laurel Highlands center on Laurel Hill and Chestnut Ridge. Because of the elevation, weather in the Laurel Highlands is generally cooler and wetter than in most other parts of the State. The Laurel Highlands are a popular area for hiking, mountain biking, hunting, trout fishing, wildlife viewing, and downhill and cross-country skiing. Since the Park is located on a plateau, there are no drastic changes in elevation within its boundaries. Elevation within the Main Unit of the Park ranges from 1,837–2,100 feet; the Jumonville Glen Unit is located between 2,198–2,346 feet; and the Braddock's Grave Unit is relatively level, with elevation change only between approximately 1,903–1,952 feet (figure 1).

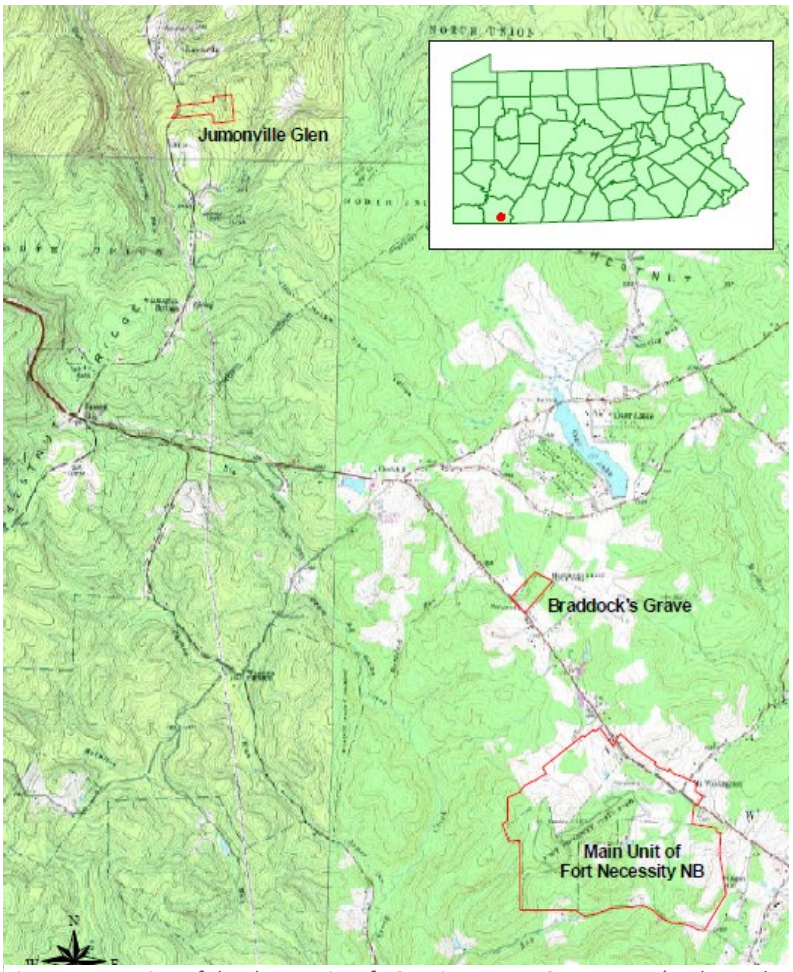


Figure 1. Location of the three units of FONE in Fayette County, PA. (Perles and others 2006)

BOUNDARIES

The boundaries of the three main FONE units are posted with NPS signs (figure 2). Although not all boundaries were walked at the time of the field review for this report, there does not seem to be any evidence of trespassing, other than the trees that were marked for harvest at the Rush Life Estate Tract. Previous timber harvests at Jumonville Glen surround the unit on three sides but do not cross the NPS boundary. There was no evidence that trees were cut on the Park's side of any of the boundaries. Trash was noted at the Braddock's Grave site adjacent to the Braddock Inn, but did not appear intentional. Windblown overflow from a dumpster at the rear of the Inn's parking lot or trash caught in snow plowing is thought to be the cause.

Figure 2. Boundary marker along the Braddock property.

FOREST TYPES

The forests of the eastern region of the United States are described as Eastern Deciduous Forests. Land use history has significantly influenced species distributions and dominance of this region. Much of this land has been cleared for agriculture, and second-, third-, and even fourth-growth forests have recolonized many sites. The effect of timber harvesting, widespread grazing, and elimination of natural fires have also had major influences on tree distribution and dominance. Invasive plant species, insects, and diseases are also having major effects on forest composition. For example, in the early 20th century, the chestnut blight (*Cryphonectria parasitica*, formerly *Endothea parasitica*) essentially eliminated the American chestnut (*Castanea dentata*) from eastern forests and caused a major change in composition that favored oaks and red maple. The hemlock woolly adelgid (*Adelges tsugae*) is threatening to eliminate eastern

hemlock (*Tsuga canadensis*) from its range in the Appalachian Mountains, and the emerald ash borer (*Agrilus planipennis*) is eliminating several species of ash (*Fraxinus* spp.) in many areas.

Mixed Mesophytic Forests

FONE lies in the mixed mesophytic forest region (Rhoads and Block 2005) within the Central Appalachians ecoregion (figure 3). The mixed mesophytic forest is the richest forest in Eastern North America with literally hundreds of species of trees and woody shrubs growing in various combinations depending on elevation, aspect, slope, and soils (Frederick and Sink 2010). The most diverse stands are found on "cove sites," or protected valleys or coves on north- and east-facing slopes. The development of these forests results from a unique set of environmental conditions consisting of high precipitation, low evaporation, moderate temperatures, and fertile soils derived from nutrient-rich sedimentary rocks. A sample of the tree species that are found in this forest type include tulip poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccarinum*), basswood (*Tilia americana*), American beech (*Fagus grandifolia*), the shrub form of American chestnut (*Castanea dentata*), yellow buckeye (*Aesculus flava*), white ash (*Fraxinus americana*), cucumber tree (*Magnolia acuminata*), northern red oak (*Quercus rubra*), butternut (*Juglans cinerea*), black walnut (*J. nigra*), chestnut oak (*Q. prinus*), mockernut hickory (*Carya alba*), shagbark hickory (*Carya ovata*), pignut hickory (*Carya glabra*), American elm (*Ulmus americana*), black cherry (*Prunus serotina*), and many more.

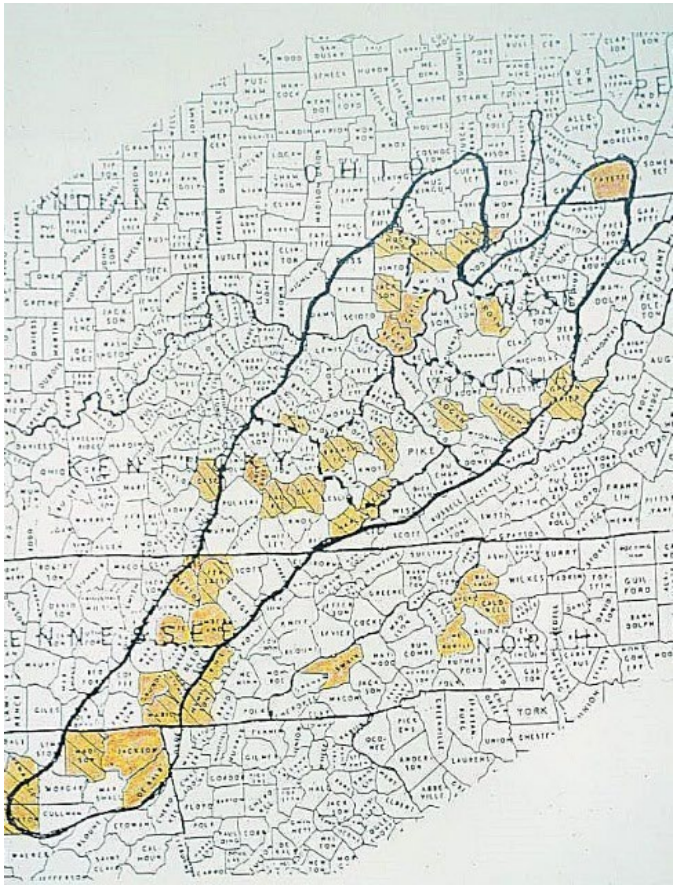


Figure 3. An outline map of the mixed mesophytic forest region. (Adapted from Braun 1950 and Kuchler 1964)

The type often has substantial components of eastern hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), and spruce (*Picea* spp.), especially on moderate quality sites or where moisture becomes limiting. This forest also has mixtures of black (*Betula lenta*) and yellow birch (*Betula alleghaniensis*).

Conifer Plantations

Most of the conifers on FONE's Main Unit were planted in the 1930s and 1950s by the Civilian Conservation Corps (CCC) and consist of pure and mixed stands of red (*Pinus resinosa*), white, and Scots pine (*Pinus palustris*); Norway spruce (*Picea abies*); and a few Japanese larch (*Larix kaempferi*). In some areas they are intermixed with hardwoods.

Red Pine (Pinus resinosa)

The red pine is a native North American tree species sometimes erroneously called "Norway pine". Its natural range is around the upper Great Lakes through southern Canada west to Manitoba. It can be found further south in the United States on high mountainous ridges. The red pine has been extensively planted far outside of its natural range in reforestation projects, parks, and in landscaping around buildings. It grows best in light, sandy, well-drained soils that are relatively low in nutrients. It does not tolerate urban conditions very well or shading by other tree species.

It is a valuable timber tree in northern Pennsylvania where its wood is used chiefly for construction lumber. It is a native species on dry slopes in Luzerne, Wyoming, Tioga, and Centre Counties and planted extensively by the Bureau of Forestry and the Pennsylvania Game Commission. Songbirds, mice, and chipmunks feed on the seeds.

Red pines in the FONE Main Unit were planted at various times 60-90 years ago. It has been noted that the red pine plantation around the two ponds near the seasonal housing incurred ice storm damage in the early 1990s. Salvaging occurred in that stand in the mid-1990s to mitigate the storm damage.

White pine (Pinus strobus)

Eastern white pines can grow to be large trees. At present they usually reach heights of 50-90 feet, but the original "Penn's Woods" had white pines that reached 150 feet and more. It is one of the most valuable timber trees in Pennsylvania, found in moist or dry woodlands throughout the State and often planted as an ornamental in large, open areas. Many birds, squirrels, chipmunks, and mice feed on the seeds and soft needles. The inner bark of white pine is a preferred winter food of porcupine, and deer browse the twigs.

Eastern white pine prefers moist, well-drained, sandy loam soils with a pH range of 4.0-6.5; however, it grows on nearly all soil types. It can establish itself on sites at both ends of the moisture scale from wet bogs and streambeds to sand plains and rocky outcroppings. In New England, it grows from sea level to 2,000 feet, but in the southern Appalachian Mountains, its elevation is restricted to 1,200-3,500 feet. Additionally, it seems to grow abundantly on north-facing slopes. It is not drought tolerant and has only a moderate ability to draw moisture from soils. This is enhanced by a symbiotic relationship to mycorrhizae, a fungus that grows on roots.

Figure 4. White and red pine stand at Braddock's Grave.

White pines in the FONE Main Unit and Braddock's Grave (figure 4) were planted at various times 60-90 years ago. It's usually found mixed with red pine.

Scots pine (Pinus sylvestris)

Scots pine is native to Eurasia, ranging from Western Europe to Eastern Siberia, south to the Caucasus Mountains and Turkey, and north to well inside the Arctic Circle in Scandinavia. It can reach 70-120 feet in height with a diameter of 3-5 feet. It's widely planted for reforestation and horticulture, and occasionally

escapes from cultivation. Where Scots pine has been intermixed with red or white pine, the Scots pine grows so much more aggressively during the first few years that its roots crowd out roots of the other species, leaving only Scots pine. Although it is used for both pulpwood and sawlogs, its principal value in the United States appears to be as a Christmas tree, ornamental specimen, and for erosion control.

Scots pine was found mixed with a stand of red pine and Norway spruce on the west side of Joan of Arc Church Road. It was not observed in other sections of the Park, but could be mixed in with the other plantations.

Norway Spruce (Picea abies)

Norway spruce is native to the European Alps, Balkan Mountains, and the Carpathians, its range extending north to Scandinavia and merging with the forests of northern Russia. It is widely planted in North America, particularly in the Northeastern United States, Southeastern Canada, and the Pacific Coast and Rocky Mountain States. Naturalized populations are known from Connecticut to Michigan and probably occur elsewhere.

For the past 100 years, this species has been extensively planted across Pennsylvania (Gilmore 2014). It grows fast and can put on 2 feet of height growth each year. Trees can grow to 100 feet at maturity and have a life span of almost two centuries in North America. It is not invasive and has been reported to rarely start new seedlings near established plantings. However, seedlings were found in the plantations at the FONE Main Unit and Braddock's Grave. They should not become invasive or dominate any future stands but become mixed with the hardwoods.

Norway spruce requires no site preparation. It is a shade-tolerant conifer that can survive dense grass cover if it is planted in fields. It is not readily damaged by deer, and rodents such as voles and mice mostly leave it alone. It has few insect pests, and can tolerate and grow in a variety of soil conditions. It will shade out grass and invasive plants such as bush honeysuckle (*Diervilla* spp.), autumn olive (*Elaeagnus umbellata*), and multiflora rose (*Rosa multiflora*). The needles will create a duff layer and allow beneficial fungi to become established. It provides important winter cover for a number of wildlife species. Grouse eat spruce needles, and a number of birds and small mammals consume the seeds.

Norway spruce has been planted at several sites throughout the FONE Main Unit. The stands at the Visitor Center, Braddock's grave, and individual trees mixed in with other conifer plantations appear to be healthy.

Description of the Forest Types at Each Fort Necessity National Battlefield Site

Fort Necessity Main Unit

The largest of the three units, this 850^{+}-acre property consists of the Great Meadows battle site, open fields, contiguous forests, and developed areas (figure 5).

The northern boundary is basically the National Road. However, there is a strip of about 38 acres on the north side of US Route 40 where the offices and visitor center used to be located, along with shrubby wetlands; a conifer plantation; and about 16 acres of hardwoods consisting of mostly oaks, tulip poplar, and red maple. A small stand of quaking aspen (*Populus tremuloides*) was discovered on the east side of the Joan of Arc Church Road. There is also a powerline right-of-way that runs parallel to Route 40.

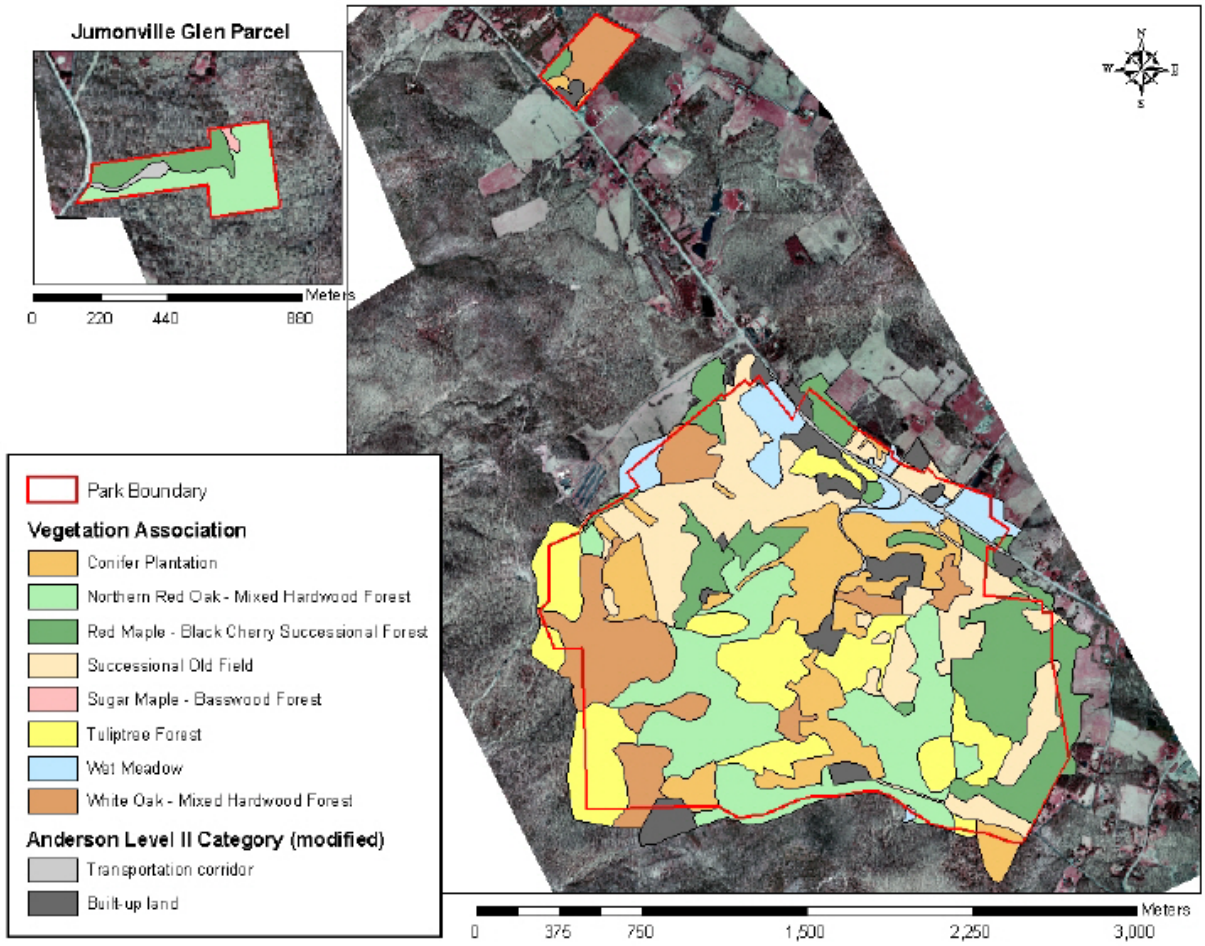


Figure 5. FONE forest types. (Perles and others 2006)

The northwestern boundary is bordered by private land consisting of an old "zoo" with buildings, parking areas, and open fields. The western, southern, and eastern property lines are bounded by private lands.

With the exception of the conifer plantations, the majority of the forested stands in the Main Unit are hardwoods. Some stands are dominated by oak, which comprises about 30 percent of the standing live trees (Perles and others 2010), while others have a larger component of black cherry, red maple (30 percent), or tulip poplar (19 percent), or are mixed equally with various hardwood species. The species diversity is exceptional; it's estimated there are more than 25 species of hardwood and 6 conifer types (Perles and others 2006). There are also smaller tree species that occupy the understory, such as sassafras (*Sassafras albidum*), choke cherry (*Prunus virginiana*), shrub-form American chestnut (*Castanea dentata*), paw paw (*Asimina triloba*), and dogwood (*Cornus florida*). Both big-tooth (*Populus grandidentata*) and quaking aspen were found scattered throughout the property of the Main Unit.

Oak species are underrepresented in the seedling and sapling layers of some of the stands (4 percent of the saplings) due to the dense shade of closed canopies; competition from shrubs, ferns, and grasses; disturbance; or possibly browse pressure from white-tailed deer. Without periodic canopy gaps (Brose and others 2008), oak seedlings are at a competitive disadvantage to other species. The Perles report from 2010 revealed that tulip poplar, which is common in the canopy, is also underrepresented in seedling and sapling layers (<1 percent), whereas red maple is abundant in all overstory layers. Although some stands have

sufficient oak and tulip poplar regeneration, it is likely that red maple will persist and become the predominant species in the future.

The rolling topography of the FONE Main Unit creates a frequent variation in slope and aspect, as well as microclimates in hollows and hilltops (Perles and others 2006). For example, south-facing or upper slopes are drier sites where species such as white and chestnut oak, black gum (*Nyssa sylvatica*), and hickory will be found, while in the coves and north-facing, lower slopes, red oak, maples, black cherry, and tulip poplar will be dominant. The gentler sloping areas and flatter terrain were often mixtures of either dry-site or cool-site species, which is not unusual.

Figure 6. Marked tree in the Rush tract.

As described previously, the conifer plantations were planted during the CCC days of the 1930s and 1950s. Red pine, white pine, and Norway spruce were commonly planted, along with Scots pine and Japanese larch. Ice storm damage in the mid- to late-1990s created openings in some areas, which allowed hardwoods to become established, creating mixed hardwood-conifer stands.

Portions of the Rush Life Estate Tract are comprised of large and mature red and white oaks, black cherry, red maple, and tulip poplar with American beech and scattered American chestnut in the understory. There is also a white pine plantation along Scotts Run Road. Black cherry reproduction in some areas was above the white-tailed deer browse line. The understory west of Hager Hill and southeast of the mowed fields is occupied by invasive Japanese barberry (*Berberis thunbergii*), which is of major concern since trees within the area have been marked for harvesting (figure 6). If harvesting occurs without control of the barberry, tree reproduction will be impaired and the barberry will continue to spread.

The area known as the camping/picnic loop and the contiguous forests of the southwest section of FONE consist of chestnut, white, and red oak; red maple; tulip poplar; hickory; and beech. The sites are very productive and the trees are tall with large crowns. White and red pine were planted at the northern extension of the picnic loop road.

Braddock's Grave

This 25^{+}-acre unit lies along the National Road about 11 miles east of Uniontown, PA (figure 7). It offers a parking area, interpretive signs, short concrete walkways, views of Braddock's Trace, and a monument to General Edward Braddock. Adjoining properties include the privately owned Braddock's Inn restaurant; tracts of private woodlands; a cultivated field in the northeast; and grassy fields to the east and west.

Figure 7. Aerial view of the Braddock's Grave tract. (Google Earth)

Quaking aspen and hickory were found closer to Braddock's Run along the Trace grave site. Several hemlocks along the Trace have been marked with blue aluminum tags as part of a U.S. Forest Service project to survey for hemlock woolly adelgid (HWA – see Forest Health Section). Multiflora rose and barberry occupy a strip between the old grave and Braddock's Run. To the west of Braddock's Run, the forest types change to mainly oaks and maples with an understory of honeysuckle.

The main portion of the property runs northeast and is composed of a contiguous stand of mixed oaks predominated by white oak, mixed with black cherry, tulip poplar, hickory, and red maple. The understory consists of white pine, Norway spruce, red maple, oaks, and cucumber tree with a few scattered shrub-sized American chestnut and other species. The majority of the trees are mature and range in age from 90 to more than 130 years. Trees that have died or fallen down are providing large gaps in the canopy. This situation can be beneficial because the light reaching the forest floor is excellent for the reproduction of the variety of tree species (figure 9). But on the other hand, the presence of fern, which is prevalent in some of these gaps, usually prohibits seedling establishment (figure 10).

With the high oak component in this stand, it will be susceptible to gypsy moth defoliation in the future. The oldest oaks may succumb after one gypsy moth defoliation (see Forest Health Section).

Along Route 40 and northwest of the monument is a plantation of white and red pine intermixed with a few Japanese larch. Morrow's honeysuckle (*Lonicera morrowii*) (figure 8) and barberry are growing around the perimeter of this plantation and along the Route 40 side and the grassed area around Braddock's monument. Most of the red and white pine are mature and were planted around the time of the CCCs. The understory species consist of white pine, red maple, elm, tulip poplar, and Norway spruce, which probably seeded in from the Norway spruce along the eastern boundary of the property.

Figure 8. Morrow's honeysuckle and Japanese barberry along the edge of the Monument area.

Figure 9. White oak reproduction.

The parking area is lined with hemlock, white pine, Norway spruce, and red and white oaks. The Norway spruce form the property line between the Park and Braddock Inn properties, and are in good health. It is recommended to remove the Morrow's honeysuckle that is growing along the edge of the parking lot (see Forest Health Section).

Figure 10. Fern may inhibit seedling reproduction.

Jumonville Glen

The 30-acre Jumonville Glen Unit sits on top of Chestnut Ridge, the westernmost ridge in the Appalachian Mountains. It is on Jumonville Road about 2.5 miles west of the National Road from the summit of Chestnut Ridge, which is about 6 miles southeast of Uniontown.

This unit consists of an entrance road, a parking area with a rest area, and a paved and gravel trail to the battle site. It's surrounded by private land to the north and east, which is owned by the Jumonville Methodist Youth Center, and to the south and west by individual landowners. The adjacent property to the south and east appear to have been harvested within the last 30-40 years, whereas the adjacent property to the north has been harvested within the last 5 years.

Figure 11. Mature red oak occupy the site throughout Jumonville Glen.

The forests on the flatter lands above the battle site are mainly mature hardwoods consisting of red maple, black cherry, and red and chestnut oaks.

The forests in the glen area are mature and are comprised of large red and chestnut oak, hickory, black cherry, sugar maple, black birch, and cucumber tree. Spicebush (*Lindera benzoin*) and witch-hazel (*Hamamelis virginiana*) were in the understory. There was very little tree reproduction in the understory due to the closed canopy.

The forests in the entire property appeared healthy and are mature (figure 11). The ages range from 80 to more than 100 years.

Several trees of concern were noted in the "island" of the parking area, and Japanese knotweed (*Fallopia japonica*) was found in a few spots along the entrance road and parking lot. A black cherry tree of concern is close to the restrooms and is recommended for removal. Gypsy moth egg masses were discovered along the paved trail near the top of the glen's rock features and in the southern portion of the property. With the high percentage of oaks, future gypsy moth defoliation could be an issue. Barberry and autumn olive were found at the end of the old access road just above the rock outcrop overlooking the glen.

Mt. Washington Tavern

The forests north of the Tavern across US Route 40 are mainly red maple and oaks, whereas the forests below, which slope to the Great Meadows, are comprised of tulip poplar, red oak, white ash, white pine, and hemlock. Healthy Norway spruce were also found a little southwest below the Tavern and appear to be part of an old property line.

Several problems were observed at the US Route 40 side of the Tavern that we are documenting here, and which are explained further in the Forest Health Section. Both ash trees in front of the Tavern are infested with emerald ash borer, as are most ash within FONE. One ash tree did not leaf out this spring and the other is dying. Both should be removed for public safety reasons.

The foliage of the hemlocks in front of the Tavern did not appear to be as full as it should be. These trees may have been infested with hemlock woolly adelgid (*Adelges tsugae*), but there is no evidence of the adelgid at the time of this writing. The Colorado blue spruce (*Picea pungens*) behind the Tavern is native to the Rocky Mountains. A canker caused by *Cytospora* attacks the lower branches first and progressively makes its way higher up the tree. The first symptom is the needles turning reddish brown and falling off. Meanwhile, patches of white resin appear on the bark and the branch eventually dies. This seems to be the case of this particular blue spruce and with most of the blue spruce around the Park Office and maintenance building. It will need to be removed in another year or two for public safety. See the Forest Health Section for further information on the canker disease.

There are several other dead and dying trees and shrubs around the Tavern and in the mowed areas around the parking lot. The hickory to the left of the Tavern is showing signs of dying (reason unknown at this time), but there may have been some damage to the root system when the new parking lot was constructed. There are two large scars on the main stem, which may have been caused by lightning. At some point this tree will need to be removed. Other trees in front of the Tavern are dead or dying. There is a possibility that a combination of road salt and mowing has damaged these trees.

Figure 12. Lawn mower damage to a flowering dogwood.

Several smaller trees, such as the redbud (*Cercis canadensis*), red maple, dogwood, and ornamental fruit trees that were planted after the new parking lot was constructed, have been damaged during mowing. The main stems of these trees are showing old wounds from mowers and weed eaters (figure 12). The bark has sloughed off some of these trees and shrubs, which makes them more susceptible to insect attack and disease. Young ash trees planted in the open areas are also damaged from mowing activity as well as from emerald ash borer. Mowing damage was also found on the roots of the Norway spruce to the right of the Tavern next to the small building that houses the wagon (figure 13).

Figure 13. Mowing damage to the roots of Norway spruce.

Remove all trees and shrubs that are showing signs of injury and replace them with native species. Tree tubes or other protection devices need to be installed around the trees to prevent injury from

mowing. Mulching will also help deter mowing injury. Maintenance contractors or Park staff need to be advised on how to protect planted materials at the Tavern and elsewhere in the Park.

The wooded area below the parking lot is similar to other stands within the Park consisting of tulip poplar, red oak, white ash, white pine, and scattered hemlock. Managing hardwood forests is described later in this document, and in the case of this stand, maintain the species composition as it is. Because of a possible future gypsy moth infestation, the oak component should remain as it currently is or be maintained between 21 and 39 percent as recommended in silvicultural guidelines of forested stands threatened by gypsy moth (Gottschalk 1993).

This same wooded area is infested with multiflora rose, barberry, Morrow's honeysuckle, and winged euonymus (*Euonymus alatus*). Japanese knotweed was found around the perimeter of the parking lot. All these invasive species were most likely established during the construction of the new parking lot and should be treated or removed.

Figure 14. Dying trees below the parking lot at Mt. Washington Tavern.

Immediately below the parking lot is a group of tulip poplar and red oak that are stressed and could be dying (figure 14). It is surmised that they were damaged during the construction of the parking area, or the hydrology changed as a result of the construction. Without further investigation it is difficult to determine the cause of the die-off.

Main Office and Maintenance Buildings

The forests surrounding the Park Office, maintenance building, and out the road to the ponds were planted by CCC crews and consist of red and white pine as well as Norway and Colorado blue spruce. In some areas the trees were planted too close together; as a result, the crowded and overtopped trees are dying out. A pocket of red pine almost directly across from the maintenance building is stressed, most likely the result of water being diverted into the woods by a ditch. Red pine prefers loamy sand or sandy loams soils with good drainage (Cook and others 1952).

Figure 15. Barberry understory adjacent to the maintenance building.

Barberry is in the understory to the east of the maintenance building (figure 15). Multiflora rose and bush honeysuckle (*Lonicera* spp.) were found in some spots around the perimeter of the access roads. Bush honeysuckles were once planted to control erosion and as hedges. They are spread by birds, which eat the fruit and disperse the seeds. In hardwood forest understories they form dense growths with thick canopies that shade out native shrubs, young trees, and wildflowers. This species poses a serious threat not only to the diversity of the ecosystems that they invade but also to forest regeneration itself because the plant is known for reducing the growth and diversity of native seedlings. The bush honeysuckle does not appear to be moving into the forests at this time; however, they should be treated or removed to prevent further establishment.

The Colorado blue spruce have the *Cytospora* canker and will die at some point (figure 16). They should be removed after they become trees of concern.

Figure 16. The Cytospora *canker has killed branches of these blue spruce. (U.S. Forest Service photo by Amy Hill)*

Mowing damage was also observed on roots and the main stems of trees around the maintenance building.

Hardwood Management Recommendations

The 2014 report on Forest Dynamics in the National Parks of the Eastern Rivers and Mountains Network (Perles and others 2014) indicated the forests in FONE were maturing. These types of forests usually have smaller stems that are being outcompeted by the canopies of the larger trees. In some cases, there is a lack of seedlings or any reproduction on the ground. This report and another stated that although oaks comprise about 25 to 30 percent of the overstory, oaks represented only 4 percent of the seedling layer. It is likely that red maple, black cherry, black birch, and white ash will dominate the overstory if there were no major disturbances. However, the ash at FONE are infested with emerald ash borer and will likely be absent from future stands. This could enable oak and other species to occupy those sites. To increase oak production, managers should consider prescribed fire, tree planting with shelters, or opening up the canopy, which would require periodic harvesting.

Although oaks were the dominant species at the time of the battle and we're recommending increasing the oak component through various methods of forest management, it should be noted that it is susceptible to gypsy moth defoliation, which will be explained further in the Forest Health Section. Park managers will need to make decisions about whether to encourage the dominance of oak species or to allow a mixture of all forest species to reduce the impacts of defoliation and possible die-off of the oak.

Recommendations:

A. **No Action**. There will be no effort to encourage management of the oak component within the three Park units or manage all the other forest species. Forest succession will occur without human intervention but may change with natural disturbances such as severe weather events or insect and disease events.
B. **Increase the Oak Component.** Silvicultural methods for even-aged forests – seed tree, shelterwood, group selection, fire, clearcutting, and others – are often used for reproducing oak (Burns 1983). The choice of these silvicultural systems and regeneration methods will depend on the objectives of Park management, the requirements of the desired species, and the potential of existing advance reproduction.

    - Clearcutting and group selection will be successful if oak seedlings and saplings are already well distributed throughout the stands. The size of the clearcuts should be determined by the stand itself, wildlife needs, esthetic impacts, or other factors. Use the shelterwood method when oaks are wanted in the next stand but advance regeneration is absent or too small. In a shelterwood cut, mature trees are removed in two or three harvests over a period of 10 to 15 years. This method allows regeneration of medium to low shade-tolerant species because a "shelter" is left to protect them.
    - The seed-tree method is like clearcutting, but with some larger or mature trees left to provide seed for establishing a new stand. Seed trees may be removed at a later date.

- Under the group selection system, a number of "groups", or small ½-acre or greater openings are created by the removal of several adjacent trees. If the groups created are large enough and if seedbed conditions are favorable, this can allow species that are shade intolerant, such as oak, to regenerate. If deer densities are high, the groups may need to be bigger to provide more browse than the deer can eat.
- Oaks can also be planted or "direct seeded", which is recommended for the fields. Planted oaks usually grow slowly and vegetation control is needed for several years to reduce competition. Direct seeded acorns must be protected from squirrels and other rodents to prevent predation.
- In young hardwood stands crop tree release may be done to maintain the development of dominant and codominant oaks and ensure attainment of desired future stocking levels of oaks.
- All equipment used in these silvicultural operations should be thoroughly cleaned or sanitized before entering Park property to avoid introducing invasive species. https://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2010.pdf

C. **Prescribed Fire**. Evidence indicates that the oak ecosystems in Pennsylvania were once influenced by periodic Native American burning. Since European settlement and subsequent cessation of human-caused burning, oak stand understories are now dominated by shade-tolerant, fire-sensitive species and do not exhibit self-replacement. Given the disturbance-dependent nature of oaks, a disturbance agent, e.g., fire, is required in order for oaks to increase across the landscape.

If a decision is made to use any of these forest management methods, consult the Pennsylvania Bureau of Forestry to develop a forest management plan for the Park.

Treatments for stands susceptible to gypsy moth. When egg masses are discovered, pest management specialists in Morgantown, WV should be contacted to determine the appropriate treatment to minimize gypsy moth impacts. Once the imminence of defoliation is determined, a stand prescription will be developed for the appropriate silvicultural techniques to be used to meet the Park's management objectives. The impacts of possible treatments on native Lepidoptera species, especially the rare state-listed species known to occur within the Park, will be considered in determining the appropriate response to gypsy moth. In areas that do not have high visitor use, the Park should consider leaving dead or dying oak trees as wildlife habitat and forest structure components.

Conifer Management Recommendations

Although none of the conifer plantations were present in 1754, most are in good health, especially the Norway spruce. The red pine stand near the ponds at the FONE Main Unit was thinned or salvaged in the mid-1990s, and sections of it appear to have sustained additional damage since then, possibly due to weather. It also appears that the trees were planted too close together, which may be why many of the smaller diameter trees are dying out. Planting too close together was observed in other conifer stands. In some cases, the recommended 8 by 8 or 10 by 10 foot spacing was obviously closer.

Recommendations:

A. **No Action**. There will be no effort to change the conifer component within the three Park units. Forest succession will occur without human intervention but may change with natural disturbances such as severe weather events or insect and disease issues. As conifers age or begin to die off, hardwoods that are currently in the understory should take their place unless the seed source of the conifers exceeds that of the hardwoods or invasive plants outcompete the hardwoods. Regardless, periodically monitor the plantations to determine whether the hardwood understory remains established in anticipation of the eventual dominance over the conifers. In some cases the natural succession may remain conifer.

B. **Phase Out Conifers in Favor of Hardwoods**. If the desired future condition is for the landscape of FONE to become what is was in the 1754 time period, phase out the plantations.

   - Rows could be thinned every 5-10 years allowing for hardwood establishment, or hardwoods could be planted between the rows of conifers if hardwood seed sources are lacking.
   - We recommend consulting with the Pennsylvania Bureau of Forestry and developing a forest management plan for the Park.
   - All equipment used in these thinning operations should be thoroughly cleaned before entering Park property to avoid introducing invasive species. https://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2010.pdf

C. **Norway Spruce Management**. We are reluctant to recommend removal of the Norway spruce, which are established around the Visitor Center, along old property boundaries, and in smaller plantations. They are very healthy, and young seedlings have been found in the understories in the FONE main unit and Braddock's Grave. Removal would deter from the current viewshed, and there may be concern from the general public.

Management of the Property North of the National Road

The acreage on the north side of US Route 40 where the offices and visitor center used to be located consists of hardwoods, a conifer plantation, open space, and shrubby wetlands.

Recommendations:

A. **No Action**. Allow the area to remain as it is. Monitor the wetland in the easternmost section to ensure it does not convert to a drier site.
B. **Phase Out the Conifer Plantation**. See the recommendations under conifer management.
C. **Pollinator Habitat**. Continue mowing where the old visitor center was located or convert it to pollinator habitat. Control invasives.

Non-Forested Areas – Grassy and Early Successional Areas

Several successional grassy/shrubby sites in the northwest section of the property are slowly reverting back to shrub land or forest land. They are most likely old pasture and post-agriculture fields, some of which are being mowed as are three to four fields in the Rush Life Estate Tract.

The fields in the western FONE unit are dominated by goldenrod, grasses, native wildflowers, hardwood species such as hawthorn (*Crataegus* spp.) and black cherry, shrubs such as viburnums (*Viburnum* spp.), blackberry (*Rubus* spp.), and spicebush, along with other herbaceous and invasive species.

The fields and pathways to the fields in the Rush Tract are being mowed, mainly for wildlife purposes and for access by hunters. Japanese stiltgrass (*Microstegium vimineum*) was observed in some pathways, which is most likely being spread by the mowing machinery.

The major management concern for the fields is the probable establishment of invasive species. Some of the fields adjacent to the Great Meadows are currently undergoing natural succession with the growth of woody species, predominantly black cherry, hawthorns, and viburnums, and Morrow's honeysuckle. In a field to the southwest of the Great Meadows, experimental honeysuckle removal plots were established in 2003 and 2004 to restore habitat for American woodcock (*Scolopax minor*). West Virginia University was involved with the study, which ended a few years ago. During 2016, invasive species were removed so that planted trees and shrubs from the woodcock study could be free to grow.

Unmanaged, these fields and those in the Rush Tract should succeed into a red maple-black cherry successional forest (Perles and others 2006). Monitor them for invasive species.

Recommendations for Old Fields:

A. **No Action**. Stop all mowing and allow the fields to naturally revert back to forests.
B. **Convert to Forests**. It's recommended to plant the fields with hardwood species of the same species types as the surrounding forested stands. Until the trees become established it will be necessary to continue mowing to control competition from herbaceous species and invasives, or controlling the invasives with herbicides. Tree shelters will also be needed to protect the trees from predation by rodents and deer.
C. **Providing Pollinator Habitat**. Approximately 160 acres of fields in the FONE Main Unit are being mowed to keep invasive plants at bay or to provide wildlife openings as is the case in the Rush Tract. Some of these fields could be set aside for pollinator habitat.

In the Appalachians, pollinators include hummingbirds, bees, beetles, butterflies, bats, and flies that carry pollen from one plant to another as they collect nectar. The lives of pollinators help to produce the fruits, vegetables, nuts, seeds, and berries of farms, gardens, and orchards as well as forests, meadows, and wetlands. According to the U.S. Fish and Wildlife Service, these hard-working animals and insects help pollinate more than 75 percent of our flowering plants and nearly 75 percent of our crops. Without them, wildlife would have fewer nutritious berries and seeds, and we would miss many fruits, vegetables, and nuts.

In June 2014, President Obama directed all Federal agencies to assist in pollinator conservation to protect our Nation's food security and to help keep pollinators healthy. The President's National Pollinator Initiative is a commitment to sustaining the future of pollinators through research, policy, education, and action. As pollinators thrive and multiply, our Nation will benefit. View the Pollinator Presidential Memorandum. View a good source of information to attract and support pollinators.

The Xerces Society for Invertebrate Conservation is a pollinator advocate on behalf of threatened, endangered, and at-risk invertebrates and their habitats. From the world's rarest butterflies, to caddisflies that live in streams, to declining bumblebee populations, the Xerces Society is dedicated to protecting invertebrates and the ecosystems that depend on them. The Society collaborates with scientists, land managers, and conservationists to raise awareness about the plight of invertebrates and to gain protection for the most vulnerable species before they decline to a level at which recovery is impossible. Destruction of habitat, introduced species, and pesticides are all leading to the loss of invertebrate species. View information on the Xerces Society's recommended seed mixes. Recommended pollinator seeds mixes are also posted on the Penn State Extension Web site.

SOILS

The valley between Laurel Hill and Chestnut Ridge is largely characterized by soils of the Gilpin-Wharton-Ernest association in low parts of the valley and the Dekalb-Hazelton-Cookport association in higher elevations. In the Main Unit and the Braddock's Grave Unit, Wharton silt loam, Gilpin channery silt loam, and Gilpin-Weikert channery silt loam are common well-drained soils associated with upland fields and forests. Ernest, Brinkerton, and Armagh silt loams are poorly drained soils associated with mesic forests and wet meadows in the southern areas of the Park. Philo silt loam, a moderately well-drained floodplain soil, is common along stream drainages in the Park's Main Unit. At the Jumonville Glen Unit and on the hilltops of the Main Unit, Hazelton channery loam, a well-drained and often stony soil, is common (Kopas and others 1973).

Soil maps in Appendix II show the soil types for the Main Unit, Jumonville Glen, and Braddock's Grave. These maps were produced from the Web Soil Survey (WSS), which is the official source of soil survey information in the U.S. The WSS provides soil data from which reports and thematic maps can be produced for identifying spatial variation in soil properties and interpretations. Additional capabilities include importing shapefiles and downloading areas of interest for use in geographical information systems, downloading whole soil survey areas, and subscribing to feeds for updates.

A more detailed soil survey of FONE was developed in March 2010 using the county-based soil survey of Fayette County (Kopas and others 1973) and in conjunction with the National Park Service's Soil Inventory and Monitoring Program. View the Soil Survey of Fort Necessity National Battlefield, Pennsylvania.

We decided not to include the FONE soil report in this document because it is approximately 200 pages. However, we described some of the soils at Braddock's Grave and Jumonville Glen. See Appendix II for additional soils information.

WATER RESOURCES

Four major streams are located within the Park's boundaries.

- Braddock Run flows through the southwestern portion of the Braddock's Grave Unit.
- The headwaters of Scott Run originate in the western portion of the Main Unit and flow south out of the Park into Big Sandy Creek.
- Indian Run flows east through the Great Meadows into Great Meadows Run.
- Great Meadows Run originates at an upstream pond north of US Route 40 and about 1.2 miles west from the main entrance to FONE. It flows south through the Great Meadows and then loops northward and exits out of the Main Unit. It eventually flows into Meadow Run, which is a tributary of the Youghiogheny River (Perles and others 2006).

Both Great Meadows Run and Indian Run appear to have been channelized and straightened, which was a routine agriculture practice. Restoration efforts will begin in 2017.

Three to four headwater streams in the western and southwestern section of the Main Unit flow into Scott's Run. A few unnamed streams that originate south of Scotts Run Road flow north into the wetlands at the main entrance to the Main Unit, then eventually flow into Meadow Run at the National Road. The outlet stream for the two ponds near the seasonal employee housing and Park offices also flows northeast into Meadow Run.

The stream at the base of Jumonville Glen (figure 17) is a headwater stream that flows north and eventually runs into Dunbar Creek, which flows into the Youghiogheny River. Braddock's Run also originates from ponds on private land north of the Braddock unit boundary. Another headwater stream originating within the unit intersects Braddock's Run midway through the property (figure 18). A few other headwater streams were found throughout the property.

Figure 17. Stream at the bottom of the glen.

None of the streams appeared to be impaired; however, we did not test any streams for turbidity, nitrates, phosphorous, dissolved oxygen, or other possible pollutants. Once the Great Meadows restoration begins, it's anticipated that Great Meadows Run and Indian Run will have sediment increases, which should be temporary and minimal if precautions are taken.

Figure 18. Tributary to Braddock's Run.

See Appendix IV for additional water resource information.

WETLANDS

We will not be describing the Great Meadows here since a management plan has already been developed by Forest Service personnel (Foster and Smith 2017) and the restoration may be underway at the time of this writing.

Wetlands and wet meadows are found in the low-lying areas of FONE where the ground is seasonally saturated with water. Other than the Great Meadows, the other wetlands observed were at the entrance to the FONE Main Unit, north of US Route 40 east of Nelson Road, and near where the old visitor center used to be located, which amounts to about 2 acres. There are also about 6 acres of wetlands in the Rush Tract where they join with the wetlands at the main entrance. The soils are classified as Philo loams, which are occasionally flooded and referred to as hydric soils. These are the same soil types that are found in the Great Meadows.

Woody species are sparse or absent, and there may be low shrubs covering some of the wetland areas. The common species found were goldenrods, sedges, cutgrass, rushes, and many of the same species that were found in the old field communities. Both wetlands and the old field provide habitat for numerous species of birds, moths, butterflies, and dragonflies.

FISH AND WILDLIFE

The rolling topography in the forested sections of FONE provides habitat for a diverse mix of bird species including the American woodcock, golden-winged warbler, field sparrows, and red-winged black bird, along with other songbirds and birds of prey. The large portions of contiguous forest lands and those of adjacent land ownerships provide for many wildlife species, including game and nongame species. White-tailed deer and black bear have been observed within the Park Main Unit, and there was evidence of deer at Jumonville Glen and Braddock's Grave.

The Pennsylvania Mammal Atlas lists about 28 species of mammals found in Fayette County.

Fish were not observed in any of the streams, but that does not mean they were absent.

THREATENED AND ENDANGERED SPECIES

Several species of Pennsylvania plants and animals have been placed on the U.S. Fish and Wildlife Service's list of Threatened and Endangered (T&E) Species in accordance with the Federal Endangered Species Act of 1973. The Pennsylvania Game Commission Web page lists the T&E species in Pennsylvania.

The Pennsylvania Natural Heritage Program provides assistance to determine if an endangered species occupies property. If there will be disturbances on the property, such as the Great Meadows restoration, a Pennsylvania Natural Diversity Inventory (PNDI) database search is required.

The PNDI search provides information pertaining to the location and status of important ecological resources such as plants, vertebrates, invertebrates, natural communities, and geologic features. On October 3, 2016, PNDIs were run on the FONE Main Unit, Braddock's Grave, and Jumonville Glen with the assistance of the Pennsylvania Bureau of Forestry. The PNDIs revealed there were sensitive species at all three locations and a geologic feature of concern at Jumonville Glen. Results are in Appendix III.

State-listed species of butterflies — black dash (*Euphyes conspicua*) and Aphrodite fritillary (*Speyeria aphrodite*) — as well as the Halloween pennant (*Celithemis eponina*) dragonfly have been documented in the Great Meadows by FONE staff (Perles and others 2006). More than likely these species can be found in the other wetland areas.

WILDFIRE

The Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry is responsible for protecting the Commonwealth's 17 million acres of public and private wildlands from damage by wildfire. This is accomplished by a combination of wildfire prevention, preparedness, suppression, and investigation. The Bureau works with fire wardens and volunteer fire departments to promote the latest advances in fire prevention and suppression.

Most people believe the greatest wildfire danger occurs during the summer. However, the greatest danger from and greatest number of wildfires is in the spring months of March, April, and May, and the autumn months of October and November. Ninety-eight percent of the wildfires in Pennsylvania are caused by people who, for example, either burn debris or carelessly toss a cigarette out a car window.

Regardless of the season, wildfires can occur in any month and at any time of the day, destroying valuable woodlands and wildlife habitat. Homes and buildings are threatened, not to mention the direct threat to human lives.

As can be seen from figure 19, FONE lies within the Bureau's Forbes District #4. In 2016 there were 92 fires covering 172 acres. Statewide statistical summaries for the years 1913 to date are available.

When there is a danger of wildfire, the Bureau of Forestry will issue advisories that may develop into burn bans. Burning bans are a tool used to alert the public and protect life, property, and natural resources from wildfire.

County burn bans usually ban open burning at the request of the District Fire Warden (usually the District Forester), in consultation with at least 10 fire chiefs or 50 percent of the fire chiefs in the county, whichever is less. Any burn ban imposed under this section (Act 1995-52) should include the above burn ban definition and remain in effect for no more than 30 days. County commissioners, upon recommendation of the District Forester, may extend the ban for up to an additional 30 days.

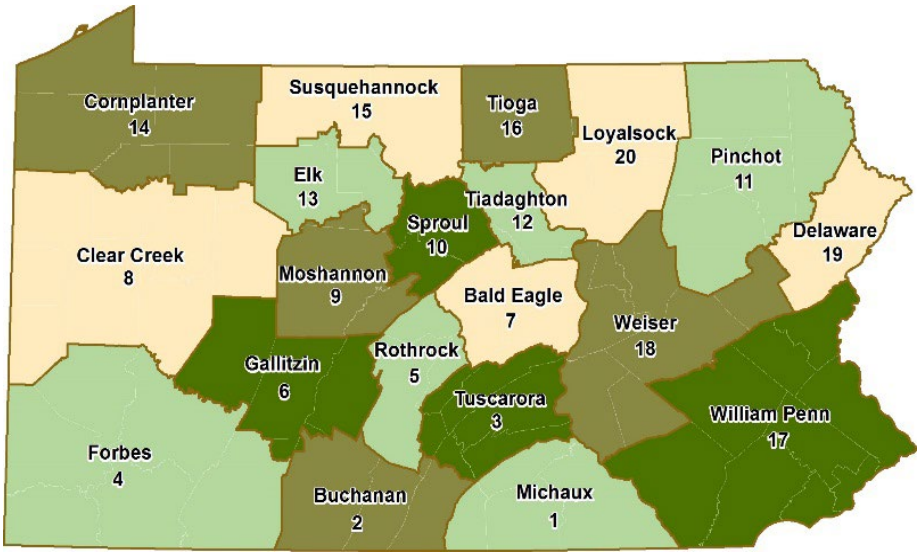


Figure 19. Bureau of Forestry Districts. (Pennsylvania DCNR)

State bans are implemented by a Governor's proclamation. State bans prohibit smoking of tobacco in any form and the building of campfires or burning of brush and other debris within woodlands or within 200 feet of woodlands within any county of the Commonwealth. A State ban is contingent on these conditions: 1) fire danger must be very high in three quarters of the State, 2) there have been 35 fires for 4 consecutive days, or 3) the entire State is in Class IV (very high fire danger) with no relief in sight. Statewide burn bans have only been implemented seven times since 1952.

Local municipalities and county offices may have additional burning restrictions or ban information. In this case it's recommended to check with local authorities to confirm where there's a ban or burning is permitted. This will alert the FONE staff to the fire danger status.

The U.S. Forest Service Wildland Fire Assessment System (WFAS) rates the danger of wildland fire in different habitats under different weather conditions from low to extreme. Definitions of the rating classes are provided in this PDF document. The most recent observed conditions and a short-term forecast are posted daily by the WFAS (follow the links under the Fire Potential/Danger heading).

The closest Pennsylvania Bureau of Forestry office to FONE:

#4 FORBES
Edward A. Callahan
1291 Route 30
PO Box 519
Laughlintown, PA 15655-0519
Tel: 724–238–1200
FAX: 724–238–5000
Email: FD04@pa.gov
District Home Page

Recommendations:

- In the event of a wildfire call 911 or the Farmington Fire Department.

- If a decision is made to allow wildfire to burn sections of the Park for the purposes of restoring oak and/or other ecosystems, contact the Bureau of Forestry and request a fire map for the Park's vegetation that shows the areas of the Park that would likely benefit from fire, and the areas from which fire should be immediately suppressed. Use this map to determine fire containment boundaries to best manage the forests within the Park.

Firewise Community Program

People moving into the country where their homes are surrounded by woodlands are often not aware of the fire danger in which they put themselves. Firefighters call the area where homes and development intermingle with undeveloped woodlands the "wildland-urban interface" or WUI.

People moving into the wildland-urban interface are not familiar with their new environment. They make choices that increase the potential for their homes to be destroyed by wildfire. Additionally there is increased risk of fires caused by debris burning, equipment use, smoking, campfires, and arson. While the TV media give more coverage to spectacular western wildfires, more fires occur east of the Mississippi River than west. Wildland fire does impact Pennsylvania.

In the case of FONE, the structures on the property are part of the WUI, but perhaps not to the extent where outside burning or campfires would endanger them. But there are other factors such as arson and equipment use, or debris burning from adjacent properties that would easily cause unwanted damage. It's important to plan for wildfire protection around the Park's structures, visitor areas, and cultural sites. Planning for wildland fire protection considers local fire codes, roofing materials, landscaping, and road placement.

To protect homeowners in the WUI, the National Fire Protection Association developed the Firewise Communities Program to save lives and property from wildfire. The program teaches people how to adapt to living with wildfire and encourages neighbors to work together and take action now to prevent losses. Although FONE is not a "community", the facility is in the WUI, and recommendations from Firewise will inform staffs how to protect the Park from wildland fire.

The Firewise Communities Program is cosponsored by the U.S. Forest Service, U.S. Department of the Interior, and the National Association of State Foresters.

Firewise liaisons are appointed by the Pennsylvania Bureau of Forestry to serve as the point of contact for Firewise in Pennsylvania.

The Firewise Liaison for Pennsylvania is:

Levi Gelnett, Wildfire Prevention Specialist
PA Department of Conservation and Natural Resources
400 Market St. RCSOB 6th Floor PO Box 8552
Harrisburg, PA 17105
Phone: 717–783–7956
Email: legelnett@state.pa.us

Wildland Fire Recommendations

These goals are intended to protect staff and visitor safety, FONE facilities, and forest resources.

Prevention:

- Practice the Firewise method around the facilities by removing burnable materials from around the structures (Appendix I).
- Contact the Forbes State Forest district office representative and request that a Pennsylvania Bureau of Forestry representative visit FONE to provide advice.
- Develop an escape plan to help with the evacuation of FONE if there is a wildland fire emergency.
- Restrict the smoking of tobacco products to designated areas.

Monitoring:

- Be observant of fire conditions, particularly during the Pennsylvania fire seasons.
- Maintain contact with the local fire warden to be aware of the current fire danger.
- Monitor the forested areas for any buildup of forest fuels on the forest floor in areas that may be prone to wildfire danger.

Suppression:

- Do not have staff attempt to fight or suppress wildland forest fires unless they have completed the proper training or have the proper fire equipment on site.
- Contact emergency professionals immediately. When a wildland fire is detected, contact the Farmington Fire Department and the Pennsylvania Bureau of Forestry at Laughlintown at 717–783–7956.

FOREST HEALTH

Invasive species are organisms new to the Appalachian forests. Outside of their native habitats, invasive species have fewer competitors and an absence of natural controls (i.e. predators, parasites, and diseases) to keep their populations in check. Invasive species cause problems for native species of all kinds, from plants to birds to amphibians, through direct competition for space and resources, as well as causing long-term changes in habitat such as soil chemistry, forest composition, and forest structure.

Make it a priority for the Park's resource managers to prevent the introduction of new invasive species through awareness and continued monitoring and management of invasive species currently present. Managing for and maintaining a diverse forest composition will also help keep the forest resilient for surviving infestations of forest pests and pathogens.

Invasive Plants

Nonnative invasive plant species pose a serious threat to the forest association in FONE. As reported by Perles and others (2010), invasive plants are a spreading threat to the Park's resources, and factors contributing to poor tree regeneration, particularly of oaks, can be attributed to invasive plants and need to be investigated further. The management and control of Japanese barberry, Morrow's and other bush honeysuckles, multiflora rose, Japanese stiltgrass, and winged euonymus should be a priority for the Park's resource managers. Reducing or eliminating all populations of these species is not feasible or attainable, but it is recommended that the Park focus on strategic allocation of resources in areas where most benefits can be gained (i.e. areas where invasives are less abundant), eradicating new populations, and management of areas for oak regeneration and species diversity.

Japanese barberry is the most widespread nonnative invasive species in Park forests. Japanese barberry is an escaped ornamental shrub that is shade tolerant and unpalatable to deer. It is spread by birds and other wildlife that eat its abundant fruits and excrete them in new locations. Barberry is so thick in the understory in some sections of the Rush tract (figure 20) that no regeneration of oak or other species was present. Thick patches of barberry inhibiting regeneration were also found on Indian Run Trail, the red pine plantation adjacent to the ponds area, and near the maintenance building. The maintenance of quality oaks, as found on the Rush tract and the interior of Braddock's Grave site, will require efforts to increase the regeneration of oak species. Any silvicultural treatments will need to include Japanese barberry removal. Currently there is very little barberry at Braddock's Grave, and removal of the root systems with a hoe, weed wrench, or mattock would be effective while very few plants are established.

Figure 20. Japanese barberry in the understory at the Rush tract.

The red pine stands adjacent to the ponds are deteriorating, and hardwoods and barberry and other invasives are becoming established. If the desired future condition for these stands is to phase out conifers and allow hardwoods to return, then monitor these stands to ensure the hardwoods are outcompeting the invasives.

Japanese Barberry Management Recommendations: Japanese barberry is most effectively controlled by recognizing its appearance early and removing isolated plants before they begin to produce seed. Manual, mechanical and chemical methods are all useful to varying degrees in controlling barberry. Removing or killing plants will provide increased light at the site which may lead to a surge of seedlings in the following year. Prepare to monitor and control these outbreaks. Mechanical controls include grubbing or pulling seedlings and mature shrubs, and repeated clipping of shrubs. Repeated mowing or cutting will control the spread of Japanese barberry but will not eradicate it. Stems should be cut at least once per growing season as close to ground level as possible. Hand-cutting of established clumps is difficult and time consuming due to the long arching stems and prolific thorns. Grubbing or pulling by hand (using a Weed Wrench or a similar tool) is appropriate for small populations or where herbicides cannot be used. Barberry has shallow roots so small plants may be pulled relatively easily when the soil is moist. Because barberry can re-sprout from root fragments remaining in soil, thorough removal of root portions is important. Manual control works well but may need to be combined with chemical treatments in large or persistent infestations.

Chemical control methods are best done during the fall when most native plants are dormant yet invasive plants are still actively growing. This lessens the risk of affecting non-target plants. The barberry's green leaves will provide easy recognition and allow for a thorough treatment at this time. Winter application of chemicals has proven to be successful as well, and further lessens the risk of damaging non-target species. Glyphosate (brand names Roundup, and for use near waterbodies, Rodeo) is a nonselective herbicide which kills both grasses and broad-leaved plants while triclopyr (brand names Garlon, Pathfinder, and others) is a selective herbicide that kills broad-leaved plants but does little or no harm to grasses. Additional control information may be found at:

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=12&cad=rja&uact=8&ved=0ahUKEwjvicyX94HWAhVKySYKHRXwBRIQFghXMAs&url=http%3A%2F%2Fwww.ct.gov%2Fcaes%2Fbarberrycontrol&usg=AFQjCNFZM1UHSl1UOPFDAgvwaF4JmofwRA

Figure 21. Japanese stiltgrass on one of the mowed roads of the Rush Tract.

Japanese stiltgrass is an annual grass that is infesting areas throughout the Park (figure 21) and is established on forest trails as well. This plant spreads by seed and is easily moved by tires, animal fur and feathers, and people's footwear. Once it becomes established in a disturbed area it outcompetes native plants, like roadsides, diminishing wildflowers and the growth of young shrubs and trees.

After it dies back in late fall, it forms a thick layer of smothering thatch that is slow to decompose and can create a fire hazard. White-tailed deer, which do not browse the grass, may facilitate spread by browsing on native species and thereby reducing competition for the Japanese stiltgrass. It can grow up to heights of 6 feet, and the seed will stay viable in the soil for up to 5 years. Because it is an annual grass, it can be controlled or eradicated if it's treated before its seed heads mature. View a field guide to the identification of Japanese stiltgrass.

***Japanese Stiltgrass Management Recommendations*:** Japanese stiltgrass was found on the road to the old water tower and on the mowed roads in the Rush Tract. Mowing or weed eating is the only option for controlling large populations of stiltgrass between early August and Labor Day before it goes to seed. Mowing stiltgrass is effective along roads and trails and, when properly timed, can destroy a majority of the seed-producing plants. However, mowing alone is often only partially effective at reducing overall stiltgrass numbers. To improve the effectiveness of mowing, cut the stiltgrass as short as possible (Richardson 2011).

A majority of the studies and research related to control of Japanese stiltgrass rely on herbicide application as a primary treatment method. Post-emergence herbicides are most effective when applied before the seed sets. Glyphosate and glufosinate (various trade names) can be used to spot treat Japanese stiltgrass in gardens and planting beds. Apply both of these broad-spectrum herbicides only to the unwanted plants.

View additional information on the control and management of Japanese stiltgrass.

Japanese knotweed was found in two small patches, one at the perimeter of the new parking area at Mt. Washington Tavern (figure 22) and the other adjacent to the parking lot at Jumonville Glen (figure 23). Eradicate these new establishments immediately before they spread into additional areas. Eliminate

Japanese knotweed with herbicides instead of mechanical removal. It only takes one fragment of one root left behind from mechanical control to keep a population thriving.

Japanese Knotweed Management Recommendations:

Knotweed stems emerge in late-March to mid-April, depending on soil temperatures, and begin a burst of rapid growth. In a warm spring, knotweed can be 6 feet tall before May 1. As frightening as the above

Figure 22. Japanese knotweed at Mt. Washington Tavern.

Figure 23. Japanese knotweed at the Jumonville Glen parking area.

ground growth of knotweed is, it is the rhizome system that is the real problem. Knotweed rhizomes spread vigorously, expanding the size of the knotweed stand. Rhizomes are also very durable. A very small piece of rhizome that is moved to another site will give rise to a new plant.

To control knotweed, the rhizome system has to be controlled. Multiple treatments need to begin to bring a knotweed infestation to a manageable level, which will take at least two years. The multiple treatment approach relies on depletion of the reserves stored in the rhizomes in the late spring, and injury through use of systemic herbicides in the late summer. A late summer application of the herbicide glyphosate is one of the most effective treatments available. Late in the growing season is when the knotweed canopy is sending sugars from photosynthesis to the rhizomes for storage. Glyphosate moves through the plant into the rhizomes with these sugars. It also has the advantage of having no soil activity. This reduces the risk of injury to non-target plants through root absorption, particularly in riparian forest buffer plantings. If glyphosate contacts the foliage of non-target plants, they will be injured or killed.

Winged euonymus is another example of an escaped ornamental shrub from Asia. This shrub is a prodigious seed producer. Many germinate where they fall, close to the mother plant, creating a dense bed of seedlings. Others are carried by birds, allowing infestations to spread rapidly. Winged euonymus easily outcompetes native plants with its large, dense silhouette. Lacking pests and tolerant of deep shade, this shrub can force itself into moist forested sites, creating large thickets that displace native herbs and shrubs. The forested area below the Mt. Washington Tavern, especially along the walkway leading to the Fort, is totally infested with winged euonymus (figure 24). Very little forest regeneration could be found, and the removal of winged euonymus is recommended before it spreads into adjacent areas. This section of the Park is also adjacent to the proposed Great Meadows restoration area. Winged euonymus seedlings up to 2 feet tall can be easily hand pulled, especially when the soil is moist. Larger plants must be dug out with a

spading fork, pulled with a weed wrench, or cut. The stump must be ground out or the regrowth clipped; be sure to remove a majority of the root system. Chemical treatments can be applied as a foliar spray or painted on cut stumps.

Figure 24. Winged euonymus downhill from Washington's Tavern.

Winged Euonymus Management Recommendations: Similar to other invasive plants, control of this plant is difficult because it produces a tremendous amount of seed. Manual, mechanical and chemical means are available to control established plantings. Seedlings can be pulled by hand and shrubs can be repeatedly cut to the ground to control re-sprouts, or cut and treated with herbicides. Once a site has been treated, it is important to replant with native vegetation to prevent further invasion. Mechanical control of seedlings up to 60 cm (2 feet) tall can be easily hand pulled, especially when the soil is moist. Larger plants and their root systems can be dug out with a spading fork or pulled with a weed wrench. Larger shrubs can be cut. The stump must be ground out or the re-growth clipped. Where populations are so large or conditions are such that cutting or other non-chemical means of control are impractical, the use of herbicides is an effective alternative. Scientific studies have shown that foliar, cut-stem and basal bark treatments have all been effective for control. Early summer treatments tend to be the most effective. Foliar spray is the best option as it is effective and efficient. For stems too tall for foliar sprays, cut stem applications can be effective as well. Two of the more widely used systemic herbicides are glyphosate and triclopyr.

Garlic mustard (*Alliaria petiolata*) is an herbaceous, invasive alien species that dominates the floor of many forests to the detriment of native species (figure 25). It is effective in quickly taking over the herbaceous layer, which has led to speculation that it may have an allelopathic effect on neighboring plants.

In the first year of growth, plants form clumps of round-shaped, slightly wrinkled leaves that smell like garlic when crushed. The next year's plants flower in spring, producing cross-shaped white flowers in dense clusters. As the flowering stems bloom they elongate into a spike-like shape. When blooming is complete, plants produce upright fruits that release seeds in mid-summer.

Figure 25. Garlic mustard on an old forest road.

***Garlic Mustard Management Recommendations*:** Preventing seed production and depleting the soil seed bank are key to eradicating infestations, but seeds can last as long as 12 years, and just one plant can produce thousands of seeds. Seeds are also easily tracked around by animals, vehicles, and people. Nonchemical, nonbiological control

methods include removal by hand pulling or cutting at the base, mowing, burning, or manipulation of the environment to reduce light. Pulling is more effective if the entire root is removed and desirable plants and soils are not trampled and compacted.

Additional control information may be found at the U.S. Forest Service, Northeastern Area State and Private Forestry Forest Invasive Plants Resource Center under "Garlic Mustard."
https://www.na.fs.fed.us/spfo/invasiveplants/factsheets/pdf/garlic-mustard.pdf

Garlic mustard was found at Braddock's Grave. It did not seem to be well established at this time but it would be advisable to treat and eradicate it while it's at low levels.

Bush honeysuckles (*Lonicera* spp.) are found throughout FONE. They include Morrow's honeysuckle, which is a problem in the old fields, along perimeters of parking areas, and in the forest understory; and Japanese honeysuckle (*Lonicera japonica*), which was primarily found across from Mt. Washington Tavern, but may also be located in other parts of FONE.

Figure 26. Morrow's honeysuckle along the forest edge at Braddock's Grave.

Bush honeysuckles will invade a wide variety of natural communities with or without previous disturbances (figure 26). Affected natural communities can include lake shores and streambanks, marshes, fens, sedge meadows, wet and dry prairies, savannas, floodplains, and upland forests and woodlands.

***Honeysuckle Management Recommendations*:** A Morrow's honeysuckle control project was accomplished on 5.4 acres at the abandoned fields located on both sides of the main entrance road during the Spring of 2007. It was recommended in a report (Whiteman and Ranson 2007) to continue repeated treatments on those areas because of the large seed bank. It's unknown whether the treatments continued beyond 2007.

Techniques for control include prescribed burning, hand pulling of seedlings, cutting, and herbicide treatments. Seedlings may be hand pulled when soils are moist. Remove all of the roots or resprouting will occur. Stems can be cut at the base with brush cutters, chainsaws, or hand tools. After cutting, apply herbicides to the cut stump either by spraying the stump with a low-pressure, hand-held sprayer or wiping the herbicide on the stump with a sponge applicator to prevent resprouting (Missouri Department of Conservation 2017).

Underplanting of native species following honeysuckle removal may be necessary to re-establish a desirable composition of ground cover, shrubs, and understory trees. This may also minimize the risk of reinvasion by bush honeysuckles and other exotic species.

Multiflora rose (*Rosa multiflora*) was once planted to stabilize soil and provide wildlife cover, but it is now invading streambanks, pastures, roadsides, and disturbed areas as well as open woodlands (figure 27). It reproduces by seed and by forming new plants from root sprouts. Fruits are readily sought by birds, which are the primary dispersers of its seeds. It has been estimated that an average multiflora rose plant may produce a million seeds per year, which may remain viable in the soil for up to 20 years.

Multiflora rose was observed in the FONE Main Unit and Braddock's Grave. Zimmerman and Yoder (2006) reported it was present in nearly 90 percent of their survey points at FONE, especially in the black cherry-red maple successional and tuliptree forest types. It was found in the old fields, but mowing was reducing its occurrences.

Figure 27. Multiflora rose along a roadside. (Courtesy photo by Richard Gardner, UMES, Bugwood.org)

***Multiflora Rose Management Recommendations*:** Multiflora rose can be controlled both mechanically and chemically. Pulling or removing individual plants is effective when plants are small. Take special care to ensure that all roots are removed to prevent resprouting. Mowing of large shrubs can provide partial control by restricting top growth and spread, but may need to be done repeatedly. Prescribed burning can be conducted early in the growing season to control severe infestations if there is enough fuel under the shrubs. Multiflora rose is also controlled using the application of systemic herbicides directly to the foliage, which is the most effective control method. Other herbicides may be applied to cut stems or as a basal bark application, combined with a surfactant or basal oil.

Forest Pests and Pathogens

White Oak – Mixed Hardwood Forest; Northern Red Oak – Mixed Hardwood Forest

Approximately 30 percent of the forest stands at FONE are in the northern red- and white oak-mixed hardwood vegetation type. Many areas, such as the recently acquired Rush Life Estate Tract and Braddock's Grave, consist of predominately over mature, medium to large oaks. Good oak regeneration was observed in the Braddock's grave parcel.

Insects

Figure 28. Gypsy moth larva. (U.S. Forest Service photo by Karen Felton)

Gypsy moth (*Lymantria dispar*) is a potential significant threat to FONE. Gypsy moth populations are currently at a very low level and historically have not been an issue with no reports of significant gypsy moth defoliation since the early 1990s. This area of the State known as the Laurel Highlands has a cooler climate and receives more precipitation than other areas of the State. These conditions are ideal for the naturally occurring gypsy moth fungus, *Entomophaga maimaiga,* which keeps gypsy moth populations at low levels.

***Gypsy Moth Management Recommendations*:** Carefully monitor gypsy moth populations on a yearly basis, especially during periods of hot and dry springs and summers. If populations increase to defoliating levels, the lack of foliage places a heavy demand on a tree's food reserves and makes it more vulnerable to attack by other organisms, such as two-lined chestnut borer and diseases.

The gypsy moth passes through four stages: egg, larva, pupa, and adult. Only the larvae (figure 28) damage trees and shrubs.

When populations are high, gypsy moth caterpillars can feed on approximately 300 species of trees and shrubs. Gypsy moth egg masses are laid on branches and trunks of trees (figure 29) and may be found in any sheltered location (e.g. under rocks, structures, firewood, etc.).

One egg mass can contain from 500 to 1,000 eggs. The hatching of gypsy moth eggs coincides with budding of most hardwood trees. Larvae emerge from egg masses from early spring through mid-May.

The most productive way to monitor gypsy moth populations is to survey for egg masses during the fall and winter months, preferably after leaf drop.

Treatments to control gypsy moth are needed when gypsy moth egg masses reach or exceed 750 egg masses per acre. Contact the U.S. Forest Service Morgantown Field Office (MFO) to assist with surveys and treatment recommendations. Aerial spraying will be recommended to prevent heavy defoliation in order to protect oak species that are an important mast producer for wildlife. Allowing defoliation and subsequent mortality would open the canopy, which would increase the growth and rate of spread of invasive plants. This is especially true for areas such as the Rush Tract (Japanese barberry) and Indian Creek Trail (Japanese barberry, multiflora rose, and autumn olive) where invasive plants are severely inhibiting regeneration of any species (figure 30). In oak-dominated forest stands that suffer severe canopy mortality as a result of gypsy moths, the Park should consider using prescribed fire in stands with some oak regeneration component in order to promote future oak forest. Prescribed fire will favor oak seedlings over maple seedlings, and eliminate invasive species. The impacts of possible treatments on native Lepidoptera species, especially the rare state-listed species known to occur within the Park, should also be considered in determining the appropriate response to gypsy moth.

Figure 29. Egg masses on the bole of a chestnut oak. (Courtesy photo by Milan Zubrik, Forest Research Institute – Slovakia, Bugwood.org)

Scattered dead and dying white ash can be found throughout FONE that have been attacked by **emerald ash borer** (*Agrilus planipennis*) (EAB). EAB feeds exclusively on ash trees but recently was found infesting white fringe tree (*Chionanthus virginicus*). White fringe tree is not native to Pennsylvania but is quite often planted as an ornamental tree. Tens of millions of ash trees have been lost to this pest, which usually kills ash trees within 3-4 years. EAB can be controlled if detected early by chemical treatment of individual trees. It is expensive, and chemicals need to be applied every 1-3 years.

Figure 30. Japanese barberry in the understory of the Rush Tract.

Figure 31. White ash infested with EAB at Mt. Washington Tavern.

***Emerald Ash Borer Management Recommendations*:** Chemical control of the few remaining ash trees on FONE is not environmentally or economically feasible. Remove the ash trees at Mt. Washington Tavern immediately because they are heavily infested with EAB (figure 31). This poses a threat to visitors because of the location of the trees to walkways and the building.

Other Forest Pests

Several native defoliators may be present throughout the year but generally do not do extensive damage such as orange-striped oakworm, buck moth, common oak moth, red-humped oakworm, tussock moths, spanworms, loopers, and skippers.

Diseases

Oak decline has been documented in Pennsylvania since the early 1900s. This decline is not caused by a single insect or disease but is instead the product of the interactions between environmental conditions and forest pests. Trees are weakened by environmental stresses such as drought, water logging, frost, and insect pests. Weakened trees are then invaded and killed by insects and diseases (e.g. two-lined chestnut borer and Armillaria root rot) that cannot successfully attack healthy trees. Usually the progression of decline is slow, occurring over several years.

Figure 32. Dieback of branches on an oak affected by oak decline. (U.S. Forest Service photo by Joseph O'Brien)

Trees affected by oak decline show a general and progressive dying back from the tip of branches (figure 32).

Other symptoms include production of chlorotic, dwarfed, and sparse foliage; development of sprouts on the main branches and stems; and premature autumn leaf color and leaf drop. Growth is often reduced before the appearance of symptoms.

***Oak Decline Management Recommendations*:** The best way to decrease oak decline is to manage oak stands to enhance overall health. Remove dead and dying trees to ensure that two-lined chestnut borer populations do not build up. Thin stands to keep trees growing vigorously and minimize competition for resources. Aggressive management of invasive plants (especially in the Rush tract) would be needed in thinned areas.

Oak wilt is caused by the fungus *Ceratocystis fagacearum.* It was first detected in mid-western Pennsylvania more than 20 years ago and is a rapid killer of red oaks. This fungus is carried by a variety of sap-feeding beetles and is difficult to diagnose. The fungus also spreads from tree to tree through root grafts; remove trees diagnosed with the disease immediately. Oak wilt is characterized by leaf wilt and drop over the entire crown, leaf portions bronzing or browning (figure 33), and rapid tree mortality.

Two-lined chestnut borer and Armillaria root rot are usually not associated with trees dying of oak wilt. In oak wilt, unlike oak decline, isolated trees or small pockets of trees can be diseased with no history of environmental stress. The infection centers are not related to site factors. Laboratory diagnosis is usually required to conclusively identify oak wilt-diseased trees.

Figure 33. Bronzing of leaves and dieback due to oak wilt. (U.S. Forest Service photo by Joseph O'Brien)

***Oak Wilt Management Recommendations*:** Please contact the MFO immediately if any oak trees exhibit the symptoms described above.

Conifer Plantations

Several conifer plantations at FONE make up approximately 14 percent of the vegetation type. These mature plantations were planted on post-agricultural fields and pastures; they consist of red pine, white pine, Scots pine, Norway spruce, and Japanese larch. In the past 25 years, ice storms and lack of thinning have caused damage and created openings in the canopy that allow hardwoods and invasive plants to become established in the understory.

Insects

The Norway spruce is the healthiest of all conifers planted at FONE. Norway spruce is tolerant of drought and wet conditions and has few insect pests. The only notable pests of Norway spruce are the Cooley spruce gall adelgid (*Adelges cooleyi*) and white pine weevil (*Pissodes strobi*). Damage from these pests is relatively minor and usually occurs on smaller and younger trees.

Red pine is also a species with few insect-related concerns since it does not have a major defoliator. However, there are defoliators that may undergo localized outbreaks, causing growth loss and, on occasion, tree mortality, but these outbreaks usually occur in young plantations.

White pine weevil is the most destructive insect pest of eastern white pine in North America (figure 34).

Trees become susceptible to injury when they reach a height of about 3 feet or are exposed to direct sunlight, which weevils prefer. Injury is confined to the previous year's terminal and infested trees are seldom killed. An infested tree will be permanently crooked, or its lateral branches may grow as leaders, which may result in a forked tree (figure 35).

Figure 34. White pine weevil on a white pine terminal. (U.S. Forest Service photo by Steven Katovich)

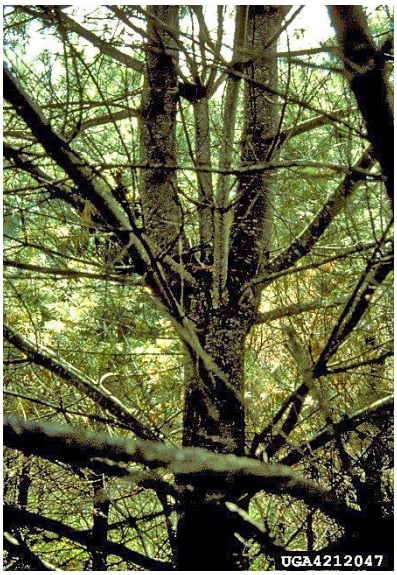


Figure 35. Forked white pine due to white pine weevil damage. (Courtesy photo by Minnesota Department of Natural Resources, Bugwood.org)

White pine regeneration growing under a hardwood or softwood overstory reduces weevil attack by slowing the growth of the leader and by reducing sunlight and temperature below what is preferred by female weevils. However, heavy shade can be detrimental to the growth of white pines. Thus, there must be a balance between sufficient shade to reduce weevil injury and enough light to maintain adequate tree growth.

***White Pine Weevil Management Recommendations*:** As a goal, maintain approximately 40 to 50 percent crown closure of overstory trees. Since the conifer stands at FONE are unmanaged and have a natural crown closure of 70 to 90 percent, white pine weevil should not be a concern for white pine regeneration.

Figure 36. Hemlock woolly adelgid line the twigs of a hemlock. (Courtesy photo by The Connecticut Agricultural Experiment Station, Bugwood.org)

Hemlock woolly adelgid (*Adelges tsugae*) (HWA) is a serious pest of eastern hemlock in the Northeastern States. HWA was first reported in southwestern Pennsylvania in 2010. HWA can be controlled with chemical treatments on individual trees. The value of the trees must be considered since treatments are expensive, will have to be repeated every 5-7 years, and are a long-term investment.

HWA feeding can kill a mature tree in about 5 to 7 years. This tiny insect (figure 36) feeds on all age classes of hemlock, from seedlings to mature and old-growth trees. Dispersal and movement of HWA is associated with wind, birds, deer, and other forest-dwelling mammals. Humans also move the adelgid on infested nursery stock and during logging and recreational activities. Natural enemies capable of maintaining low-level HWA populations are nonexistent in Eastern North America.

HWA produces a white, woolly coat that is easily observed because it contrasts with the hemlock foliage. Look for the presence or absence of the white, woolly masses of HWA at the base of needles on the underside of hemlock branches. In some cases, usually late summer to early fall, HWA nymphs may be present but not yet covered by a white, woolly mass. Not finding HWA on the lower branches does not mean they are not present. In many instances, high levels of HWA can be found in the upper canopy of trees but nothing is detected in the lower canopy. If you see any branches on the ground that have broken from the upper canopy from previous wind storms, examine the foliage.

***Hemlock Woolly Adelgid Management Recommendations*:**
Eastern hemlock is not a major component of the forest types at FONE with only a few scattered trees next to the visitor center and at Braddock's Grave. To date, HWA has not been detected at FONE.

Figure 37. Hemlocks adjacent to the visitor parking lot.

The row of eastern hemlocks growing adjacent to the parking lot at the visitor center have poor form (figure 37) and are heavily forked from damage during the sapling stage. Due to the expense and long-term investment of chemical treatments, it is recommended to not treat these trees when they become infested. If the Park would like to continue with a conifer cover, it is recommended to underplant this area with Norway and/or red spruce (*Picea rubens*) or white pine. As hemlocks decline over time, spruce or pine will already be established. If white pine are underplanted they will need protection from white-tailed deer.

The mature eastern hemlocks growing along the paved trail between the visitor center and the Fort provide shade for visitors, are intermingled with healthy Norway spruce, and provide shade and soil stability along the banks of Indian Run. If left unattended from HWA infestations, these hemlocks would eventually die and would need to be removed due to hazards to the public. Several healthy hemlock trees are located adjacent to the parking lot at Braddock's Grave and along Braddock's trail to Braddock's Run (figure 38).

Figure 38. Hemlocks at Braddock's Grave.

Chemical treatment is recommended for these trees to continue species diversity, reduce the potential for trees of concern, and provide shade to reduce the

establishment and spread of invasive plant species currently established (Morrow's honeysuckle, Japanese barberry).

The hemlocks at Mt. Washington Tavern have poor form (broken tops) and sparse foliage (figure 39). HWA is not present; the stress could be attributed to location, road salt, and previous storm damage. Chemical treatment is only recommended at the Tavern if FONE wants to continue with a conifer cover. Treatment at this point is no guarantee that the trees will recuperate or survive. Annually monitor all hemlocks and contact the MFO for technical and financial assistance when HWA is detected.

Figure 39. Hemlocks located at Washington's Tavern.

Diseases

For many decades, white pine health has been adversely affected by the nonnative **white pine blister rust** (*Cronartium ribicola*) and the native white pine weevil. Additional native white pine stressors that have received little or no attention have recently been linked to declining health of white pine throughout North America.

In the Northeastern U.S., **Caliciopsis canker** (*Caliciopsis pinea*), a stem canker pathogen, poses a significant threat to white pine health. In the past 10-15 years, white pines have succumbed to an increase in the occurrence and severity of *C. pinea* infestations; these infestations result in excessive resin production, leading to serious growth declines and commercial defects in lumber. External symptoms include crown thinning, cankers, and profuse pitching (figure 40).

Figure 40. Caliciopsis canker on white pine. (Courtesy photo by Jill Rose, WV Dept. of Ag.)

From recent surveys conducted on 360,000 acres of white pine forest (defined as >75 percent white pine basal area) in Maine, Massachusetts, and New Hampshire, *C. pinea* cankers occurred on 36 percent of the surveyed land.

In the southern Appalachians there has been an increase of dieback and mortality symptoms in white pine since 2006, especially in the mountains of Georgia, Virginia, and West Virginia. These symptoms include branch flagging, canker presence, high resin pitching associated with cankers, and mortality across a range of tree diameters. Embedded within these various cankers were immature pine scale insects, which were later identified via DNA analysis as *Matsucoccus macrocicatrices*, the first report of this scale in the Southeastern U.S. Surprisingly, *M. macrocicatrices* is common in the Northeastern U.S. and Canada and is known as the "Canadian pine scale," but the insect has not been investigated as an associate of *C. pinea* infestations. Because the scale is frequently associated with *C. pinea* infections on white pine trees in the Southeast, this indicates a previously undescribed relationship between insect and fungus affecting white pine health that should be further explored.

Needle Diseases

White pine stands in the Northeast are also facing an emerging foliar disease complex, **white pine needle damage**, which will likely remain a problem in years with excessive springtime moisture (figure 41).

White pine needle damage results from one or several fungal pathogens native to North America. In addition to brown spot caused by *Lecanosticta acicola* (formally *Mycosphaerella dearnessii*), several other species of fungi have been isolated from diseased pine needles at a high frequency that may represent novel white pine pathogens. Unfortunately, there is still limited information on the basic etiology, epidemiology, and management of these pathogens on eastern white pine. While mortality resulting from white pine needle damage has not been reported, continued defoliation will weaken trees, making them more susceptible to other biotic and abiotic stresses.

Figure 41. White pine needle damage from brown spot. (U.S. Forest Service photo by Amy Hill)

Figure 42. Fabrella needle blight. (Courtesy photo by Pennsylvania DCNR – Forestry, Bugwood.org)

***White Pine Needle Disease Management Recommendations*:** To date, there are no management recommendations for these diseases listed above. Although the multiple stress agents associated with white pine health issues make it a challenge to study, strategies aimed at improving white pine health are readily available. White pine has long been successfully regenerated using silvicultural methods and responds very well to thinning. Continued research and monitoring for these diseases will help gain a better understanding of white pine health issues with the hope to recommend treatments that reduce the risk of white pine damage due to these stressors.

In December 2002, a stand of native hemlock trees was observed to have unusual needle cast symptoms in both overstory and understory trees. Further examination of the affected needles revealed signs of a fungal pathogen, later identified as **Fabrella needle blight** (*Fabrella tsugae*), a pathogen first detected in Clearfield County in 1974 (figure 42). Fabrella was first detected in Fayette County in 2002.

Fabrella needle blight causes needles to turn brown and drop off in late summer, particularly in the lower crown. Damage is generally not considered to be significant, but can lead to twig and branch dieback when coupled with other stressors such as drought or hemlock woolly adelgid.

Figure 43. Eastern hemlock tip blight. (Courtesy photo by Maine Forest Service)

A tip blight on eastern hemlocks, *Sirococcus tsugae*, was first observed in 2006 in Maine and can now be found across the Northeast. **Eastern hemlock tip blight** apparently affects only the tips of branches, seldom killing more than 0.5 inches of shoot tip growth (figure 43).

Often, however, tens or hundreds of shoot tips can be affected on a single tree.

Infection has been observed only on current-season shoot tips, so primary infection is believed to occur early in spring, probably within days after new shoot growth is initiated. Symptoms are most easily observed in the spring, but the infected dead tip will stay attached to the shoot for several months. Spore-producing structures of the fungus may be seen on individual needles with a hand lens, but are sometimes difficult to see and are often not present.

The disease is especially apparent on understory advance regeneration of hemlocks in natural stands.

***Fabrella Needle Blight and Eastern Hemlock Tip Blight Management Recommendations*:** Damage from either disease is generally not considered significant and there are no current management recommendations.

Red Maple – Black Cherry Successional Forest

Approximately 13 percent of the vegetation type on FONE is red maple – black cherry successional forest. This forest type occurs on sites that were formally cleared for agriculture.

Insects

The **Asian longhorned beetle** (*Anoplophora glabripennis*) (ALB) is a serious pest that was discovered attacking trees in Brooklyn, NY, in 1996 (figure 44). Since its initial discovery in New York, it has been found in four additional States (IL, NJ, MA, and OH). Tunneling by the beetle larvae girdles tree stems and branches. Repeated attacks lead to dieback of the tree crowns and eventually tree death. The beetle prefers maple species but other hosts include birches, Ohio buckeye (*Aesculus glabra*), elms, horse chestnut (*Aesculus hippocastanum*), and willows (*Salix* spp.). Currently, the only effective means to eliminate ALB is to remove infested trees and destroy them by chipping and burning. To date, ALB is a regulated pest by the USDA Animal and Plant Health Inspection Service (APHIS) and, if discovered, eradication procedures are conducted.

Figure 44. Adult Asian longhorned beetle and exit hole. (Courtesy photo by Kenneth R. Law, USDA APHIS PPQ, Bugwood.org)

***Asian Longhorned Beetle Management Recommendations*:** Prohibit out-of-state firewood for use in recreational areas. ALB and other wood-infesting species can be transported in firewood; once they arrive in new areas, these invaders can quickly become established and severely damage forests.

Annually monitor for adult beetles during the late summer months or survey for large exit holes in maple trees, especially in high-use recreational areas. Immediately contact MFO if any suspect sightings or reports are made.

Other Insects

Native defoliators, such as leafrollers and loopers, may be present on maple throughout the year but generally do not do extensive damage.

The most important defoliating insects that attack black cherry include the eastern tent caterpillar (*Malacosoma americanum*) and cherry scallop shell moth (*Hydria prunivorata*). Infestations of these insects are sporadically heavy, with some apparent growth loss and occasional mortality if heavy defoliations occur several years in a row.

***Native Defoliator Management Recommendations*:** None.

Diseases

Black knot, a native disease caused by the fungus *Apiosporina morbosa,* is common on black cherry. It causes elongated, rough, black swellings several times the diameter of the normal stem (figure 45).

Small twigs may be killed within a year after infection. Large cankerous swellings, a foot or more in length, may occur on the trunks of larger trees; several such lesions scattered along the bole render a tree worthless for lumber.

***Black Knot Management Recommendations*:** None.

Figure 45. Black knot gall on black cherry. (U.S. Forest Service photo by Joseph O'Brien)

Tuliptree Forest

This forest type makes up approximately 14 percent of FONE. The dominant tree is tuliptree (also known as yellow-poplar) that also shares dominance with red maple, black cherry, and northern red oak.

Insects

The **yellow-poplar weevil** (*Odontopus calceatus*) is a native of the Eastern United States (figure 46). It overwinters as an adult at the base of the host tree and as soil temperatures warm up, adults emerge and feed on new growth. When populations are at high levels, leaves appear shredded and the feeding damage turns brown and gives the foliage a scorched look.

Tuliptree scale (*Toumeyella liriodendra*) is a key pest of tuliptree and magnolia (figure 47).

Figure 46. Yellow-poplar weevil and damage. (Courtesy photo by Tim Tigner, Virginia Department of Forestry, Bugwood.org)

Figure 47. Tuliptree scale. (Courtesy photo by Lacy L. Hyche, Auburn University, Bugwood.org)

This soft scale can become so prolific that it quite often covers twigs and branches. Large numbers of these scales may give an infested twig a warty appearance. Feeding by the pest may weaken regeneration by removing plant fluid and could cause the rapid decline of an infested tree.

***Yellow-Poplar Weevil and Tuliptree Scale Management Recommendations*:** There are natural enemies that keep both pests under control. They do not usually threaten tree longevity or growth since populations increase to detectable levels only on occasion.

Diseases

No major diseases.

Sugar Maple – Cucumber Tree Forest

This forest type makes up less than 1 percent of FONE but is found only in the Jumonville Glen unit of the Park. The major tree species are cucumber tree, sugar maple, northern red oak, and red maple.

Insects

See description of gypsy moth and Asian longhorned beetle in previous sections.

Diseases

No major diseases.

Other Threats

Viburnum leaf beetle (*Pyrrhalta viburni*) (figure 48) was discovered in Cayuga County, New York, in July 1996. By 2008, this species had spread to other areas in Canada and the States of Maine, New York, Pennsylvania, Vermont, Massachusetts, and Ohio. Heavy infestations can defoliate viburnum, cause dieback, and eventually kill the plants (figure 49).

Figure 48. Adult viburnum leaf beetle. (Courtesy photo by Paul Weston, Cornell University, Bugwood.org)

Viburnums repeatedly defoliated over a period of 2 to 3 years are likely to die. This beetle is restricted to feeding on species of Viburnum and has strong preference for the popular arrowwood (*Viburnum dentatum*). Viburnum is an important wildlife food source, especially for birds, and its flowers support several species of butterflies. Currently viburnum can be found in FONE, and the future restoration of the Great Meadows wetland area may increase the amount of viburnum on the site. If viburnum will be planted as part of the restoration efforts, then viburnum species that are more resistant to the viburnum leaf beetle should be selected for planting.

***Viburnum Leaf Beetle Management Recommendations*:** Pruning and destroying infested twigs after egg laying (figure 50) is the most effective means of control but is probably not practical for large patches in natural settings. Conduct monitoring from July to September for terminal twigs with characteristic egg "caps" arranged in straight rows, which are characteristic of viburnum leaf beetle infestation. Contact the Morgantown Field Office if suspect populations are found.

Figure 49. Defoliation from viburnum leaf beetle. (Courtesy photo by E. Richard Hoebeke, Cornell University, Bugwood.org)

Figure 50. Egg laying damage by viburnum leaf beetle. (Courtesy photo by Dawn Dailey O'Brien, Cornell University, Bugwood.org)

On September 22, 2014, the Pennsylvania Department of Agriculture (PDA), in cooperation with the Pennsylvania Game Commission, confirmed the presence the **spotted lanternfly** (*Lycorma delicatula*) in Berks County, Pennsylvania, the first detection of this nonnative species in the United States. Upon determination that the potential impact on Pennsylvania's agricultural economy and natural resources was great, the PDA issued a quarantine on November 1, 2014, with the intent to restrict the movement of the spotted lanternfly. The most recent detections are in Montgomery and Lehigh Counties.

Figure 51. Adult spotted lanternfly. (Courtesy photo by Lawrence Barringer, Pennsylvania Dept. of Ag., Bugwood.org)

The spotted lanternfly is a plant hopper native to China, India, and Vietnam that has been introduced in South Korea and Japan (figure 51).

This pest is known to utilize 25 species of plants that grow in Pennsylvania, including cultivated grapes, fruit trees, and hardwood species. In the U.S., the spotted lanternfly has the potential to greatly impact the viticulture (grape), tree fruit, plant nursery, and timber industries. This pest poses a significant threat to the State's more than $20.5 million grape industry, nearly $134 million apple industry, and more than $24 million stone fruit industry, as well as the hardwood industry in Pennsylvania, which accounts for $12 billion in sales.

Figure 52. Spotted lanternfly egg masses. (Courtesy photo by Holly Raguza, Pennsylvania Department of Agriculture, Bugwood.org)

In Pennsylvania, the spotted lanternfly overwinters in egg masses laid on smooth bark, stone, and other vertical surfaces (figure 52). The first of four immature stages, or instars, begin emerging from the egg masses in mid-May, with a few individuals that molt to second instar nymphs by the end of May. The first instar nymph is black with white spots and is wingless. As it grows, the spotted lanternfly develops red patches in addition to the white spots. Nymphs spread from the initial site by crawling or jumping up any woody or nonwoody plant it comes across to feed.

In the fall, adults prefer Tree of Heaven (*Ailanthus altissima*) as their primary food source, mating, and egg-laying location. However, Tree of Heaven is not the only tree or surface the spotted lanternfly will lay eggs upon – any smooth-trunked tree, stone, or vertical smooth surface can provide a potential host for eggs masses. Manmade items such as vehicles, campers, yard furniture, farm equipment, or any other items stored outside are suitable sites for egg laying. Egg laying begins in late September and continues through late November or early December.

***Spotted Lanternfly Management Recommendations*:** Survey areas with Tree of Heaven during the fall and winter months. Egg masses may be found on other smooth-surfaced outdoor items, such as lawn furniture, stone and brick work, and outdoor recreational vehicles. The egg mass poses, perhaps, the greatest risk for accidental transport of the spotted lanternfly to new areas.

To date, spotted lanternfly is a pest that is regulated by USDA APHIS; if it is discovered, eradication procedures are conducted. Immediately contact MFO if any suspect sightings or reports are made.

Recently, Japanese barberry has been implicated in the spread of **Lyme disease** (*Borrelia burgdorferi*). Researchers have noted higher densities of adult deer ticks and white-footed and deer mice under barberry than under native shrubs. Japanese barberry has denser foliage than most native species. As a result, the plants retain higher humidity levels. Relative humidity under a barberry is about 100 percent at night. The plant exists in an umbrella-like form, so the daytime humidity drop is much more subtle under the canopy of barberry than under other plants. Ticks need humidity and become desiccated when levels drop below 80 percent. The shrubs also provide nesting areas for white-footed mice and other rodents, which are primary sources for larval ticks' first blood meal.

***Japanese Barberry Management Recommendations*:** Several areas in FONE are heavily infested with Japanese barberry, especially in the Rush Tract, near the maintenance building, and along Indian Run Trail. This invasive exotic plant is a serious and growing threat to the Park's resources. Make extra effort to control Japanese barberry in the high-use visitor areas a priority.

Over the last decade, **Bot canker** (*Diplodia corticola*) (*Dc*) has emerged as an important canker pathogen of oaks in the U.S. and Europe. In fall 2014, large overstory red oak with premature leaf browning and drop, bleeding/sooty bark cankers, and associated mortality were reported from Seneca State Forest (SSF) in Greenbrier County, West Virginia.

Surveys conducted in 2015-16 revealed crown dieback and mortality of additional red oaks throughout the SSF, with some showing prolonged radial growth decline visible in cross section. Disease symptoms included bleeding/sooty cankers (figures 53 and 54), crown dieback, and bark cracking as was confirmed in 2015. In 2016, this disease was also confirmed in Clearfield County, Pennsylvania.

Figure 53. Bleeding canker of red oak from bot canker. (U.S. Forest Service photo by Danielle Martin)

Figure 54. Bleeding canker of red oak. (U.S. Forest Service photo by Danielle Martin)

It is unknown how *Dc* colonizes oaks; however, other members of the Botryosphaeriaceae generally enter plants through wounds, leaf scars, or stomata. It is suspected to be spread by air, water splash, or contaminated pruning tools. Members of this family often live as harmless endophytes until the plant is stressed, at which time they become pathogenic. The fungus may colonize dead tissue and then move into healthy tissue. To date, no links to insect vectors have been discovered.

***Bot Canker Management Recommendations*:** Please contact the Morgantown Field Office immediately if any red oak trees exhibit the symptoms described above.

Beech bark disease represents a unique relationship between the beech scale insect *Cryptococcus fagisuga* and the fungal pathogen *Nectria coccinea* var. *faginata.* This disease appeared on beech trees following introduction of the beech scale from Europe in Nova Scotia at the turn of the 20th century. Since then the scale insect spread throughout New England and arrived in Pennsylvania by 1958.

Figure 55. Beech scale insects produce a white, waxy crust. (Courtesy photo by Pennsylvania DCNR – Forestry, Bugwood.org)

Beech bark disease is a canker disease caused by the *Nectria* fungus. Feeding by the beech scale facilitates entry by the fungal pathogen. The scale insect produces white, waxy filaments that form a small but noticeable waxy crust on the tree (figure 55).

Stands of beech recently infested with beech scale may not develop cankers for several years. Eventually the *Nectria* fungus does become established. The scale and fungal pathogen work in combination to kill patches of inner bark. Cankers can expand and join to girdle and kill the tree (figure 56).

To date, beech scale has not been located in Fayette County, Pennsylvania. A small stand of beech can be found on the picnic loop right before entering the picnic area.

***Beech Bark Disease Management Recommendations*:** Monitor these beech trees for the presence of scale. Please contact the MFO if suspect sightings are made. There are no management recommendations for beech bark disease, but some beech trees are known to be resistant to the scale insect. Leaving resistant trees intact allows these trees to disperse seed, which produces more trees that are scale resistant and fewer diseased trees in the future.

Figure 56. Nectria coccinea *canker. (Courtesy photo by Pennsylvania DCNR – Forestry, Bugwood.org)*

APPENDIX I. PENNSYLVANIA FIRE LAW

C8170-FM-FR0092 9/2015 RULES AND REGULATIONS
TITLE 17. PENNSYLVANIA CODE, PART I. DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
Subpart C. STATE FORESTS
CHAPTER 21. GENERAL PROVISIONS

21.118. Fires.

(a) *Prohibition.* Fires are prohibited except in accordance with this section.

(b) *Gas grills and camp stoves.* Fires are permitted in gas grills and camp stoves when these appliances are used as designed.

(c) *Charcoal fires.* Charcoal fires are permitted in appliances designed for them. Disposing of hot charcoal, except in a facility designed for charcoal disposal, is prohibited.

(d) *Fire rings.* Fires are permitted in fire rings that are either provided by the Department or, if not provided by the Department, do not exceed 2 feet in diameter. Fire rings must be constructed of noncombustible material.

(e) *Fireplaces.* Fires are permitted in fireplaces provided by the Department.

(f) *Forest-fire danger.* Fires in fire rings and fireplaces are prohibited at the following times unless permitted by the Department:

(1) When the forest-fire danger is determined by the Department to be high, very high or extreme.

(i) The Department will notify the public of these danger ratings by means of the Department's web site, signs, news releases, fire wardens or volunteer fire departments.

(ii) The public may contact the district forester to obtain forest-fire danger ratings.

(2) From March 1 through May 25.

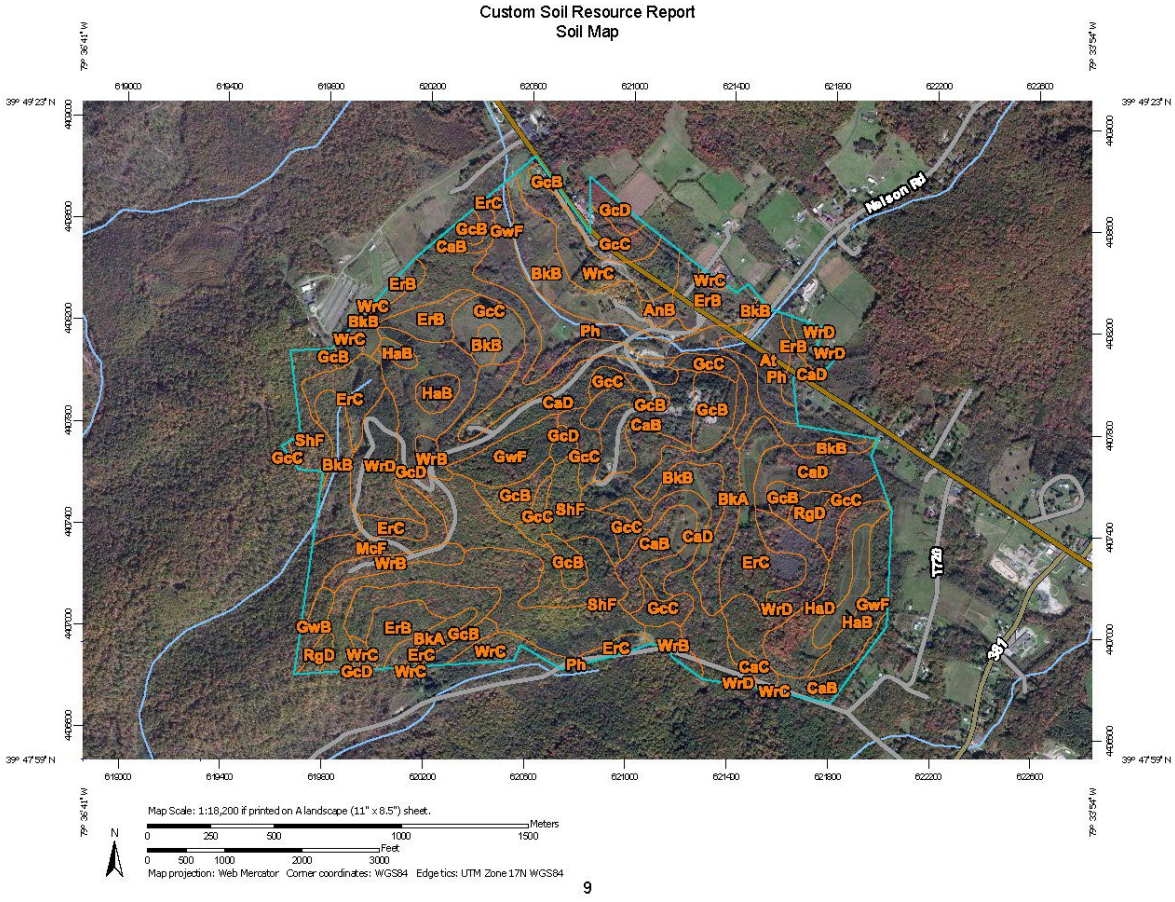
(g) *Attending a fire.* Failure to attend a fire at all times is prohibited.

(h) *Extinguishing a fire.* Leaving a fire that has not been completely extinguished is prohibited.

(i) *Liability.* A person who has caused a wildfire, in addition to possible criminal penalty, is liable for damages, costs of extinction and fines.

APPENDIX II. SOILS

Fort Necessity Main Unit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Soil Map
Nelson Rd
Map Scale: 1:18,200 if printed on A landscape (11" x 8.5") sheet.
Meters
Feet
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84
9

For additional interpretation of these soils, please see Soil Survey of Fayette County, Pennsylvania and the Soil Survey of Fort Necessity National Battlefield, Pennsylvania.

Braddock's Grave

9

Three types of soils were found at the Braddock's Grave site: Ernest silt loam, Hazelton channery sandy loam, and Wharton silt loam.

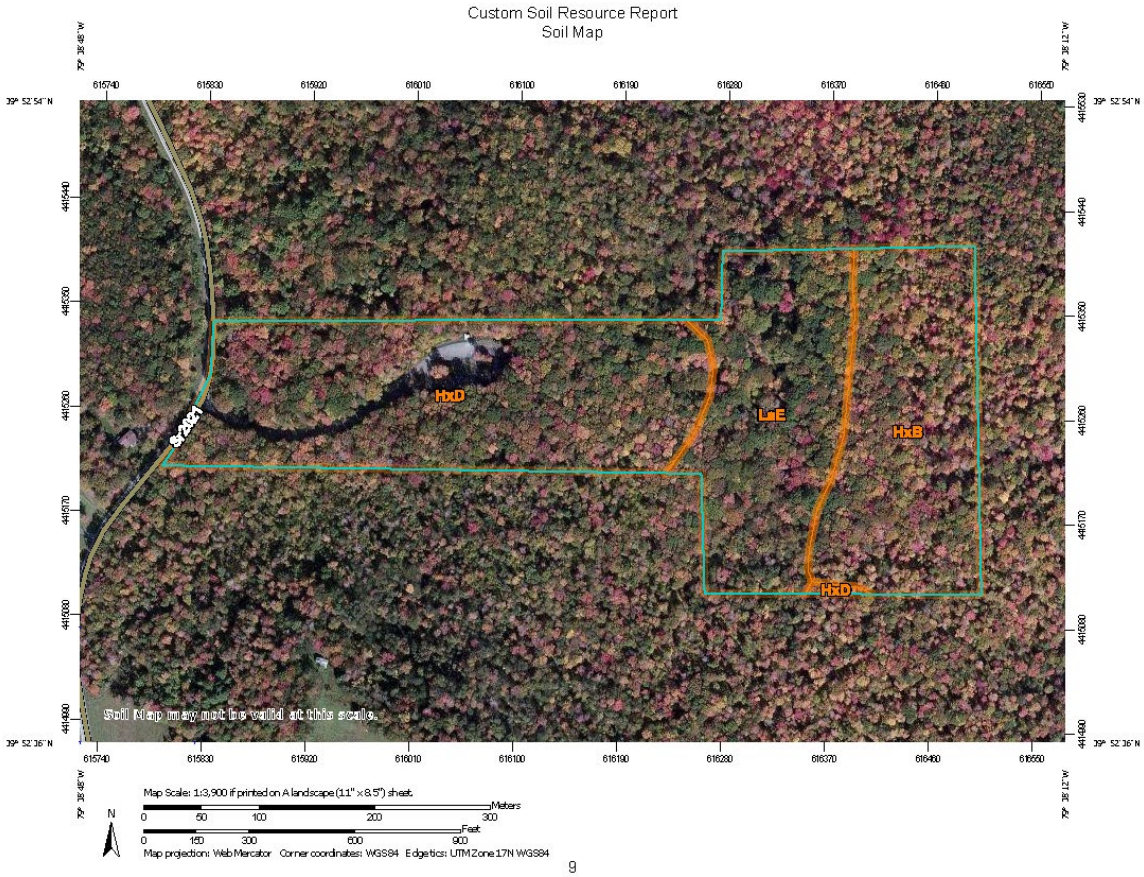
1. The Ernest series consists of deep, moderately well-drained, loamy soils that are widely distributed throughout Fayette County. The site quality for sugar maple, upland oaks, ash, and tulip poplar is very good.
2. The Hazelton series consists of deep, well-drained, loamy soils of the uplands. They are very permeable with a water table less than 3 feet below the surface. They are suited to farming and are cultivated or wooded.
3. Wharton silt loams are deep, moderately well-drained soils that have a loamy surface layer and a clayey subsoil.

Farm or Pasture Suitability: The Ernest silt loams are classified as farmland of State importance; Hazelton and Warton silt loams are prime farmland.

Woodland Suitability: All soils are very suitable for woodlands. Common trees are maple, oak, beech, hickory, ash, hemlock, elm, cucumber, red and black oak, and tulip poplar.

Management Considerations: There are slight equipment limitations due to the seasonable high water table on the Ernest and slow permeability and seasonal high water table of the Warton.

Jumonville Glen



9

Only two types of soils are found here.

1. HxB and HxD are the **Hazelton-Clymer complex** with 0 to 8 percent slopes and 8 to 25 percent slopes, respectively. They are generally located on and along Chestnut Ridge and Laurel Hill and along the Youghiogheny River. Most of these soils are very stony. Smooth or slightly convex shoulders and backslopes on mountain ridges. They are generally not suited for cultivation or pasture.

   Moderately suited to northern red oak and tulip poplar; well suited to chestnut oak.

2. LaE is the Laidig gravelly loam, 25 to 35 percent slopes. Smooth or slightly convex footslopes and backslopes on the lower mountainsides and valley sides. They are moderately suited for cultivation and pasture but the hazard of erosion, rate of surface runoff, and the loss of nutrients are increased because of the slope. Because of the limited available water capacity, plants may suffer from moisture stress during the drier summer months.

   Pasture Suitability: Moderately suited.
   Woodland Suitability: Well suited to northern red oak and eastern white pine; moderately suited to yellow-poplar.
   Management Considerations: Because of the slope, the safe operation of equipment and the hazard of erosion during the construction of haul roads and log landings are management concerns. The operation of logging trucks is unsafe and the operating efficiency of the trucks and of harvesting and mechanical planting equipment is reduced because of the slope.

APPENDIX III. PENNSYLVANIA NATURAL DIVERSITY INDEX

Fort Necessity Main Unit

Pennsylvania Department of Conservation and Natural Resources
PNDI Receipt: project_receipt_fort_necessity_614248_1.pdf

Project Search ID: PNDI-614248

1. PROJECT INFORMATION

Project Name: **Fort Necessity**
Date of Review: **10/3/2016 11:35:04 AM**
Project Category: **Forest Stewardship Plan**
Project Area: **946.40 acres**
County(s): **Fayette**
Township/Municipality(s): **WHARTON**
ZIP Code: **15437**
Quadrangle Name(s): **FORT NECESSITY**
Watersheds HUC 8: **Cheat; Youghiogheny**
Watersheds HUC 12: **Meadow Run; Upper Big Sandy Creek**
Decimal Degrees: **39.810071, -79.588571**
Degrees Minutes Seconds: **39° 48' 36.2547" N, 79° 35' 18.8549" W**

2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	No Known Impact	No Further Review Required
PA Department of Conservation and Natural Resources	**Potential Impact**	**FURTHER REVIEW IS REQUIRED, See Agency Response**
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	No Known Impact	No Further Review Required

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

NOT TO BE USED FOR

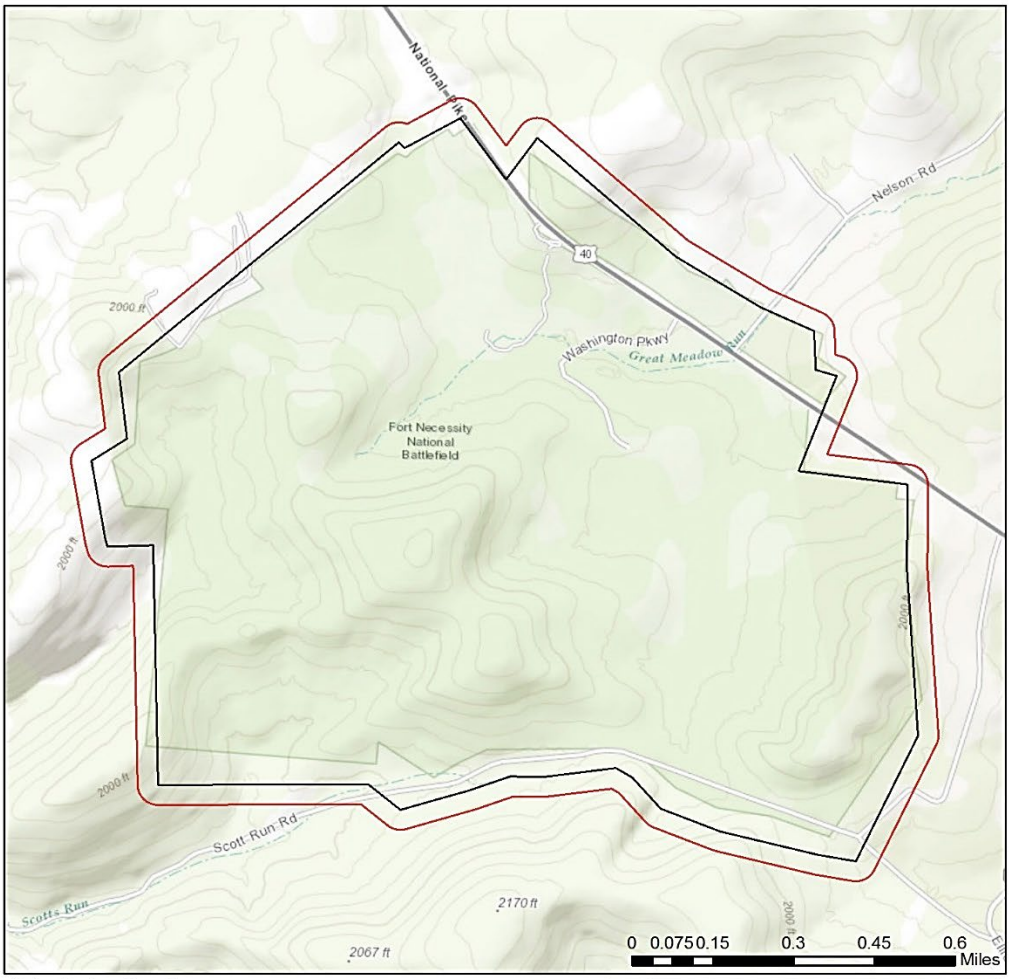
Fort Necessity

Project Boundary

Buffered Project Boundary

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Fort Necessity



Project Boundary

Buffered Project Boundary

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are valid for two years (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jurisdictional agencies strongly advise against conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission
RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

PA Department of Conservation and Natural Resources
RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

DCNR Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below. After desktop review, if a botanical survey is required by DCNR, we recommend the DCNR Botanical Survey Protocols, available here: http://www.gis.dcnr.state.pa.us/hgis-er/PNDI_DCNR.aspx.)

Scientific Name	Common Name	Current Status	Proposed Status	Survey Window
Houstonia purpurea var. purpurea	Purple Bluets	Special Concern Species*	Threatened	flowers April-Aug
Hypericum densiflorum	Bushy St. John's-wort	Threatened	Special Concern Species*	flowers July-aug

PA Fish and Boat Commission
RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service
RESPONSE:

No impacts to federally listed or proposed species are anticipated. Therefore, no further consultation/coordination under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq. is required. Because no take of federally listed species is anticipated, none is authorized. This response does not reflect potential Fish and Wildlife Service concerns under the Fish and Wildlife Coordination Act or other authorities.

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictional agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

Braddock's Grave

Pennsylvania Department of Conservation and Natural Resources
PNDI Receipt: project_receipt_braddocks_grave_614246_1.pdf

Project Search ID: PNDI-614246

1. PROJECT INFORMATION

Project Name: Braddock's Grave
Date of Review: 10/3/2016 11:20:49 AM
Project Category: Forest Stewardship Plan
Project Area: 38.61 acres
County(s): Fayette
Township/Municipality(s): WHARTON
ZIP Code: 15437
Quadrangle Name(s): FORT NECESSITY
Watersheds HUC 8: Cheat
Watersheds HUC 12: Upper Big Sandy Creek
Decimal Degrees: 39.833624, -79.599678
Degrees Minutes Seconds: 39° 50' 1.473" N, 79° 35' 58.8397" W

2. SEARCH RESULTS

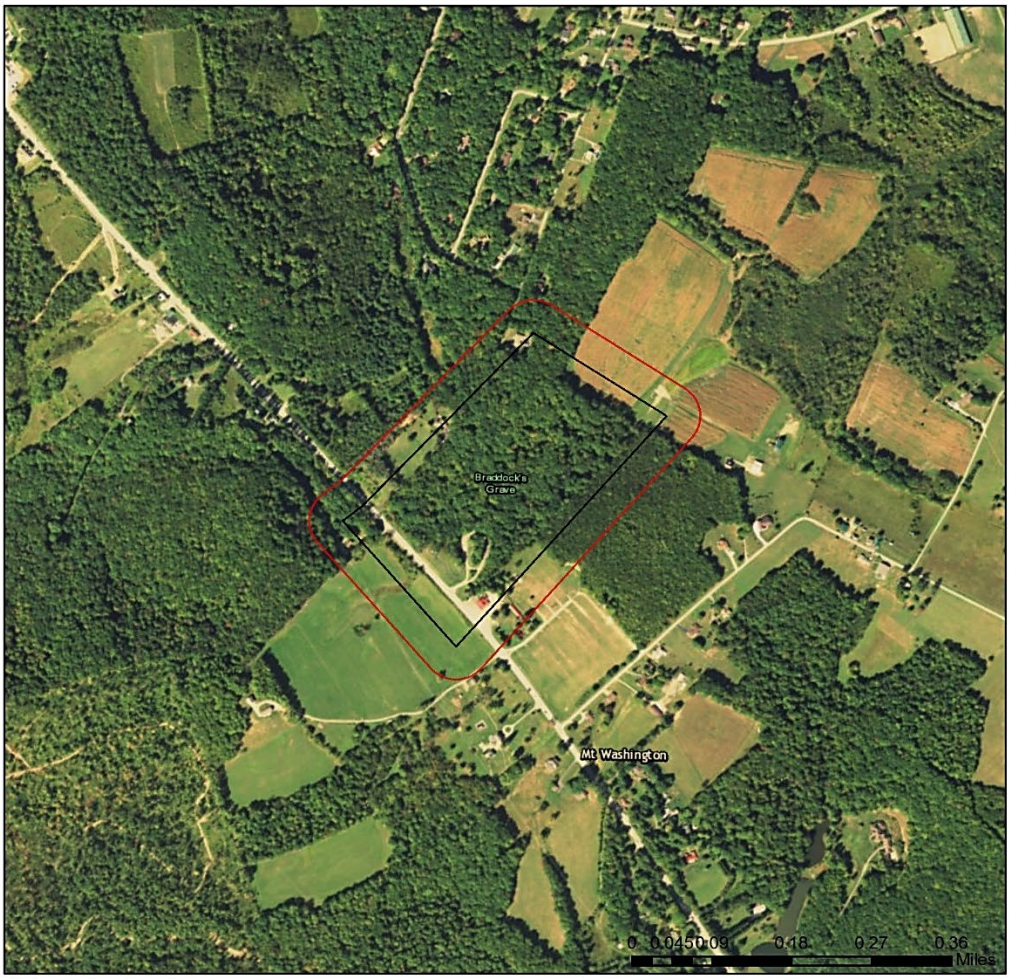
Agency	Results	Response
PA Game Commission	Conservation Measure	No Further Review Required, See Agency Comments
PA Department of Conservation and Natural Resources	Potential Impact	FURTHER REVIEW IS REQUIRED, See Agency Response
PA Fish and Boat Commission	No Known Impact	No Further Review Required
U.S. Fish and Wildlife Service	Avoidance Measure	See Agency Response

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

NOT FOR PUBLIC USE

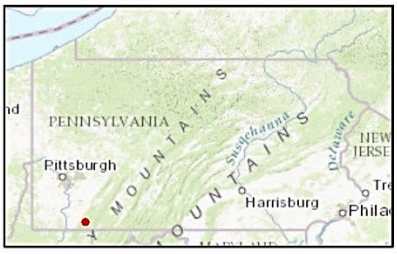
Page 1 of 6

Braddock's Grave



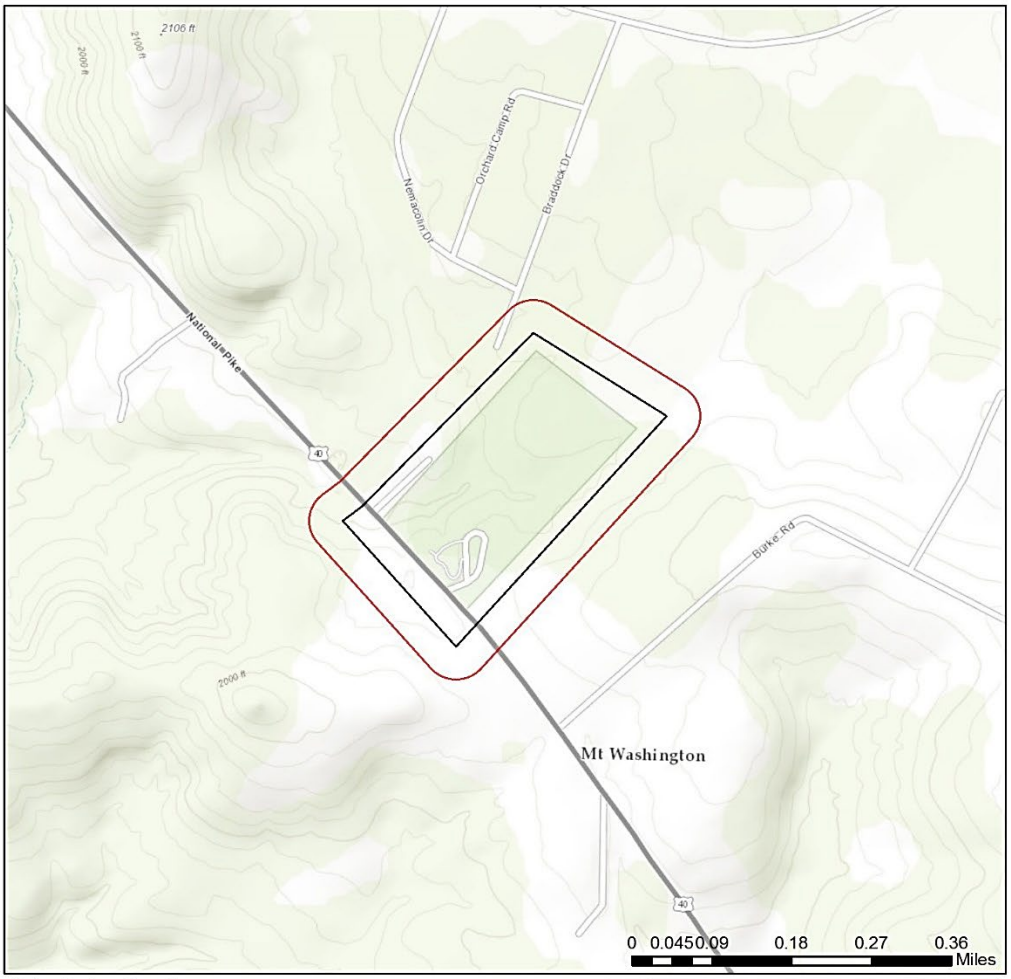
Project Boundary

Buffered Project Boundary



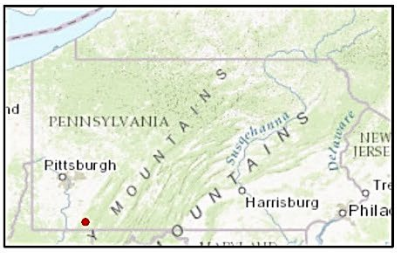
Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Braddock's Grave



Project Boundary

Buffered Project Boundary



Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are valid for two years (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jurisdictional agencies strongly advise against conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission
RESPONSE:

Conservation Measure: Potential impacts to state and federally listed species which are under the jurisdiction of both the Pennsylvania Game Commission (PGC) and the U.S. Fish and Wildlife Service may occur as a result of this project. As a result, the PGC defers comments on potential impacts to federally listed species to the U.S. Fish and Wildlife Service. No further coordination with the Pennsylvania Game Commission is required at this time.

PA Department of Conservation and Natural Resources
RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

DCNR Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below. After desktop review, if a botanical survey is required by DCNR, we recommend the DCNR Botanical Survey Protocols, available here: http://www.gis.dcnr.state.pa.us/hgis-er/PNDI_DCNR.aspx.)

Scientific Name	Common Name	Current Status	Proposed Status	Survey Window
Houstonia purpurea var. purpurea	Purple Bluets	Special Concern Species*	Threatened	flowers April-Aug

PA Fish and Boat Commission
RESPONSE:

No Impact is anticipated to threatened and endangered species and/or special concern species and resources.

U.S. Fish and Wildlife Service
RESPONSE:

Avoidance Measure: To avoid adverse effects on Indiana bats and their habitat, implement the Fish and Wildlife Service's Forest Management Guidelines for Indiana Bat Swarming Habitat, found at https://www.fws.gov/northeast/pafo/endangered/forestry.html.

As the project proponent or applicant, I certify that I will implement the above Avoidance Measure:
_____(Signature)

SPECIAL NOTE: If you agree to implement the above Avoidance Measure, no further coordination with this agency regarding threatened and endangered species and/or special concern species and resources is required. If you are not able to comply with the Avoidance Measures, you are required to coordinate with this agency - please send project information to this agency for review (see "What to Send" section).

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictional agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, upload* or email* the following information to the agency(s). Instructions for uploading project materials can be found here. This option provides the applicant with the convenience of sending project materials to a single location accessible to all three state agencies. Alternatively, applicants may email or mail their project materials (see AGENCY CONTACT INFORMATION).
*Note: U.S. Fish and Wildlife Service requires applicants to mail project materials to the USFWS PA field office (see AGENCY CONTACT INFORMATION). USFWS will not accept project materials submitted electronically (by upload or email).

Check-list of Minimum Materials to be submitted:
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____A map with the project boundary and/or a basic site plan (particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
In addition to the materials listed above, USFWS REQUIRES the following
____SIGNED copy of a Final Project Environmental Review Receipt

The inclusion of the following information may expedite the review process.
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams.

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. Two review options are available to permit applicants for handling PNDI coordination in conjunction with DEP's permit review process involving either T&E Species or species of special concern. Under sequential review, the permit applicant performs a PNDI screening and completes all coordination with the appropriate jurisdictional agencies prior to submitting the permit application. The applicant will include with its application, both a PNDI receipt and/or a clearance letter from the jurisdictional agency if the PNDI Receipt shows a Potential Impact to a species or the applicant chooses to obtain letters directly from the jurisdictional agencies. Under concurrent review, DEP, where feasible, will allow technical review of the permit to occur concurrently with the T&E species consultation with the jurisdictional agency. The applicant must still supply a copy of the PNDI Receipt with its permit application. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. The applicant and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at https://conservationexplorer.dcnr.pa.gov/content/resources.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a preliminary screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552
Harrisburg, PA 17105-8552
Email: RA-HeritageReview@pa.gov
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Pennsylvania Field Office
Endangered Species Section
110 Radnor Rd; Suite 101
State College, PA 16801
NO Faxes Please

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA 16823
Email: RA-FBPACENOTIFY@pa.gov

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA 17110-9797
Email: RA-PGC_PNDI@pa.gov
NO Faxes Please

7. PROJECT CONTACT INFORMATION

Name:_____
Company/Business Name:_____
Address:_____
City, State, Zip:_____
Phone:(_____)_____Fax:(_____)_____
Email:_____

8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

_____ _____
applicant/project proponent signature date

PNDI Jumonville Glen

Pennsylvania Department of Conservation and Natural Resources
PNDI Receipt: project_receipt_jumonville_glen_614247_1.pdf

Project Search ID: PNDI-614247

1. PROJECT INFORMATION

Project Name: Jumonville Glen
Date of Review: 10/3/2016 11:26:49 AM
Project Category: Forest Stewardship Plan
Project Area: 40.22 acres
County(s): Fayette
Township/Municipality(s): NORTH UNION; WHARTON
ZIP Code: 15445
Quadrangle Name(s): UNIONTOWN
Watersheds HUC 8: Lower Monongahela; Youghiogheny
Watersheds HUC 12: Cove Run-Redstone Creek; Dunbar Creek
Decimal Degrees: 39.879854, -79.641114
Degrees Minutes Seconds: 39° 52' 47.4749" N, 79° 38' 28.92" W

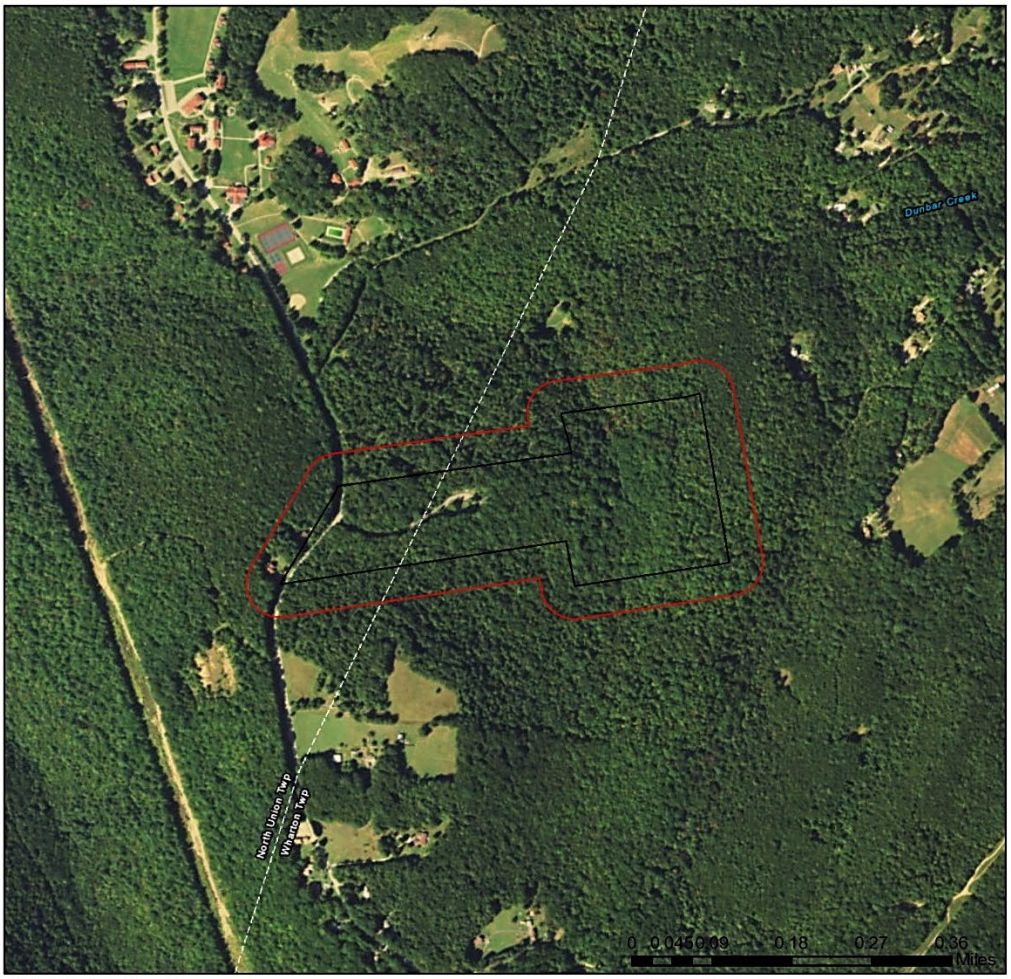
2. SEARCH RESULTS

Agency	Results	Response
PA Game Commission	Conservation Measure	No Further Review Required, See Agency Comments
PA Department of Conservation and Natural Resources	Conservation Measure	No Further Review Required, See Agency Comments
PA Fish and Boat Commission	Potential Impact	FURTHER REVIEW IS REQUIRED, See Agency Response
U.S. Fish and Wildlife Service	Avoidance Measure	See Agency Response

As summarized above, Pennsylvania Natural Diversity Inventory (PNDI) records indicate there may be potential impacts to threatened and endangered and/or special concern species and resources within the project area. If the response above indicates "No Further Review Required" no additional communication with the respective agency is required. If the response is "Further Review Required" or "See Agency Response," refer to the appropriate agency comments below. Please see the DEP Information Section of this receipt if a PA Department of Environmental Protection Permit is required.

NOT FOR PUBLIC USE

Jumonville Glen

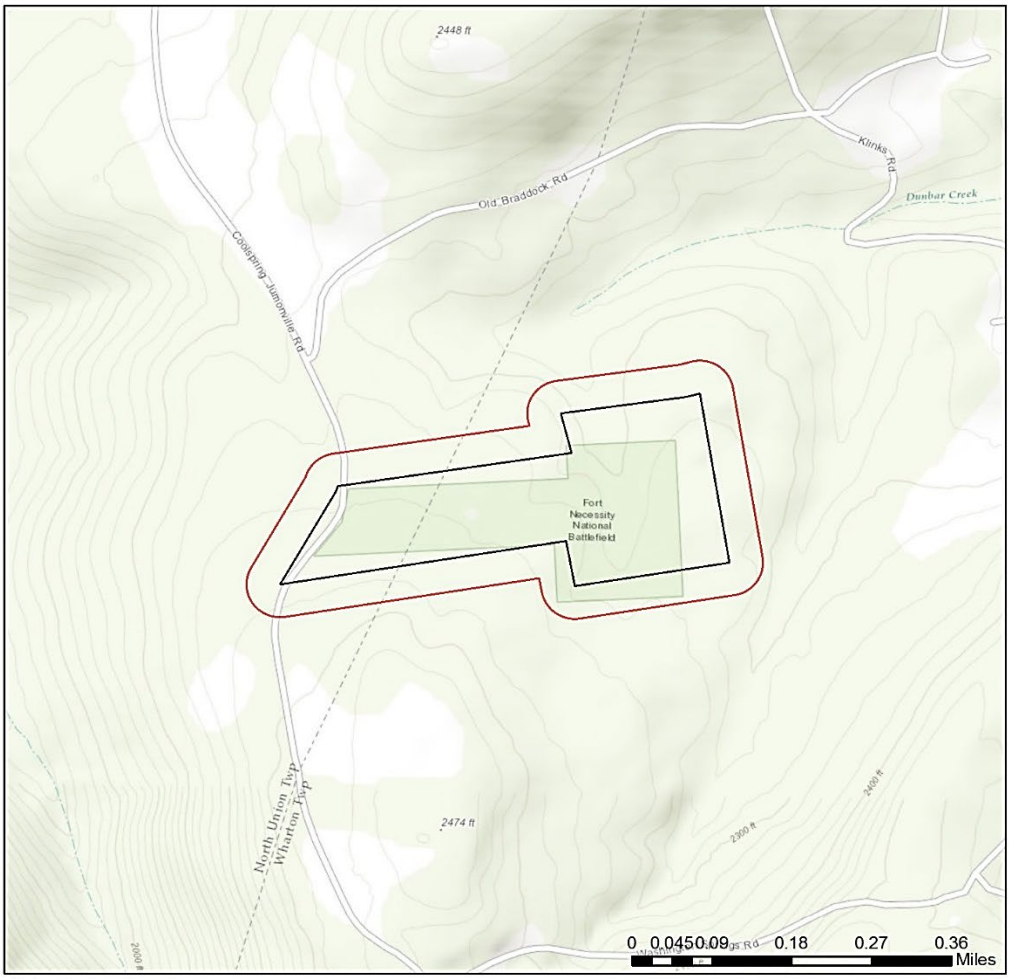


Project Boundary

Buffered Project Boundary

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Jumonville Glen



Project Boundary

Buffered Project Boundary

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

3. AGENCY COMMENTS

Regardless of whether a DEP permit is necessary for this proposed project, any potential impacts to threatened and endangered species and/or special concern species and resources must be resolved with the appropriate jurisdictional agency. In some cases, a permit or authorization from the jurisdictional agency may be needed if adverse impacts to these species and habitats cannot be avoided.

These agency determinations and responses are valid for two years (from the date of the review), and are based on the project information that was provided, including the exact project location; the project type, description, and features; and any responses to questions that were generated during this search. If any of the following change: 1) project location, 2) project size or configuration, 3) project type, or 4) responses to the questions that were asked during the online review, the results of this review are not valid, and the review must be searched again via the PNDI Environmental Review Tool and resubmitted to the jurisdictional agencies. The PNDI tool is a primary screening tool, and a desktop review may reveal more or fewer impacts than what is listed on this PNDI receipt. The jurisdictional agencies strongly advise against conducting surveys for the species listed on the receipt prior to consultation with the agencies.

PA Game Commission
RESPONSE:

Conservation Measure: Potential impacts to state and federally listed species which are under the jurisdiction of both the Pennsylvania Game Commission (PGC) and the U.S. Fish and Wildlife Service may occur as a result of this project. As a result, the PGC defers comments on potential impacts to federally listed species to the U.S. Fish and Wildlife Service. No further coordination with the Pennsylvania Game Commission is required at this time.

PA Department of Conservation and Natural Resources
RESPONSE:

Conservation Measure: One or more geologic features of special concern is known on or near your site. There are voluntary options to augment, restore or reduce the impact to these resources. We encourage you to contact the PA Bureau of Topographic and Geologic Survey (ishaulis@pa.gov or 717-702-2037) for more information on the feature and specific recommendations.

DCNR Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below. After desktop review, if a botanical survey is required by DCNR, we recommend the DCNR Botanical Survey Protocols, available here: http://www.gis.dcnr.state.pa.us/hqis-er/PNDI_DCNR.aspx.)

Scientific Name	Common Name	Current Status	Proposed Status	Survey Window
Erosional remnant	Erosional Remnant	Special Concern Resource*	Special Concern Resource*	

PA Fish and Boat Commission
RESPONSE:

Further review of this project is necessary to resolve the potential impact(s). Please send project information to this agency for review (see WHAT TO SEND).

PFBC Species: (Note: The Pennsylvania Conservation Explorer tool is a primary screening tool, and a desktop review may reveal more or fewer species than what is listed below.)

Scientific Name	Common Name	Current Status
Sensitive Species**		Threatened

U.S. Fish and Wildlife Service
RESPONSE:

Avoidance Measure: To avoid adverse effects on Indiana bats and their habitat, implement the Fish and Wildlife Service's Forest Management Guidelines for Indiana Bat Swarming Habitat, found at https://www.fws.gov/northeast/pafo/endangered/forestry.html.

As the project proponent or applicant, I certify that I will implement the above Avoidance Measure:
_____(Signature)

SPECIAL NOTE: If you agree to implement the above Avoidance Measure, no further coordination with this agency regarding threatened and endangered species and/or special concern species and resources is required. If you are not able to comply with the Avoidance Measures, you are required to coordinate with this agency - please send project information to this agency for review (see "What to Send" section).

* Special Concern Species or Resource - Plant or animal species classified as rare, tentatively undetermined or candidate as well as other taxa of conservation concern, significant natural communities, special concern populations (plants or animals) and unique geologic features.
** Sensitive Species - Species identified by the jurisdictional agency as collectible, having economic value, or being susceptible to decline as a result of visitation.

WHAT TO SEND TO JURISDICTIONAL AGENCIES

If project information was requested by one or more of the agencies above, upload* or email* the following information to the agency(s). Instructions for uploading project materials can be found here. This option provides the applicant with the convenience of sending project materials to a single location accessible to all three state agencies. Alternatively, applicants may email or mail their project materials (see AGENCY CONTACT INFORMATION).
*Note: U.S. Fish and Wildlife Service requires applicants to mail project materials to the USFWS PA field office (see AGENCY CONTACT INFORMATION). USFWS will not accept project materials submitted electronically (by upload or email).

Check-list of Minimum Materials to be submitted:
____Project narrative with a description of the overall project, the work to be performed, current physical characteristics of the site and acreage to be impacted.
____A map with the project boundary and/or a basic site plan (particularly showing the relationship of the project to the physical features such as wetlands, streams, ponds, rock outcrops, etc.)
In addition to the materials listed above, USFWS REQUIRES the following
____SIGNED copy of a Final Project Environmental Review Receipt

The inclusion of the following information may expedite the review process.
____Color photos keyed to the basic site plan (i.e. showing on the site plan where and in what direction each photo was taken and the date of the photos)
____Information about the presence and location of wetlands in the project area, and how this was determined (e.g., by a qualified wetlands biologist), if wetlands are present in the project area, provide project plans showing the location of all project features, as well as wetlands and streams.

4. DEP INFORMATION

The Pa Department of Environmental Protection (DEP) requires that a signed copy of this receipt, along with any required documentation from jurisdictional agencies concerning resolution of potential impacts, be submitted with applications for permits requiring PNDI review. Two review options are available to permit applicants for handling PNDI coordination in conjunction with DEP's permit review process involving either T&E Species or species of special concern. Under sequential review, the permit applicant performs a PNDI screening and completes all coordination with the appropriate jurisdictional agencies prior to submitting the permit application. The applicant will include with its application, both a PNDI receipt and/or a clearance letter from the jurisdictional agency if the PNDI Receipt shows a Potential Impact to a species or the applicant chooses to obtain letters directly from the jurisdictional agencies. Under concurrent review, DEP, where feasible, will allow technical review of the permit to occur concurrently with the T&E species consultation with the jurisdictional agency. The applicant must still supply a copy of the PNDI Receipt with its permit application. The PNDI Receipt should also be submitted to the appropriate agency according to directions on the PNDI Receipt. The applicant and the jurisdictional agency will work together to resolve the potential impact(s). See the DEP PNDI policy at https://conservationexplorer.dcnr.pa.gov/content/resources.

5. ADDITIONAL INFORMATION

The PNDI environmental review website is a preliminary screening tool. There are often delays in updating species status classifications. Because the proposed status represents the best available information regarding the conservation status of the species, state jurisdictional agency staff give the proposed statuses at least the same consideration as the current legal status. If surveys or further information reveal that a threatened and endangered and/or special concern species and resources exist in your project area, contact the appropriate jurisdictional agency/agencies immediately to identify and resolve any impacts.

For a list of species known to occur in the county where your project is located, please see the species lists by county found on the PA Natural Heritage Program (PNHP) home page (www.naturalheritage.state.pa.us). Also note that the PNDI Environmental Review Tool only contains information about species occurrences that have actually been reported to the PNHP.

6. AGENCY CONTACT INFORMATION

PA Department of Conservation and Natural Resources
Bureau of Forestry, Ecological Services Section
400 Market Street, PO Box 8552
Harrisburg, PA 17105-8552
Email: RA-HeritageReview@pa.gov
Fax:(717) 772-0271

U.S. Fish and Wildlife Service
Pennsylvania Field Office
Endangered Species Section
110 Radnor Rd; Suite 101
State College, PA 16801
NO Faxes Please

PA Fish and Boat Commission
Division of Environmental Services
450 Robinson Lane, Bellefonte, PA 16823
Email: RA-FBPACENOTIFY@pa.gov

PA Game Commission
Bureau of Wildlife Habitat Management
Division of Environmental Planning and Habitat Protection
2001 Elmerton Avenue, Harrisburg, PA 17110-9797
Email: RA-PGC_PNDI@pa.gov
NO Faxes Please

DRAFT FOR ACTUAL USE
NOT FOR ACTUAL USE

7. PROJECT CONTACT INFORMATION

Name:_____
Company/Business Name:_____
Address:_____
City, State, Zip:_____
Phone:(_____)_____Fax:(_____)_____
Email:_____

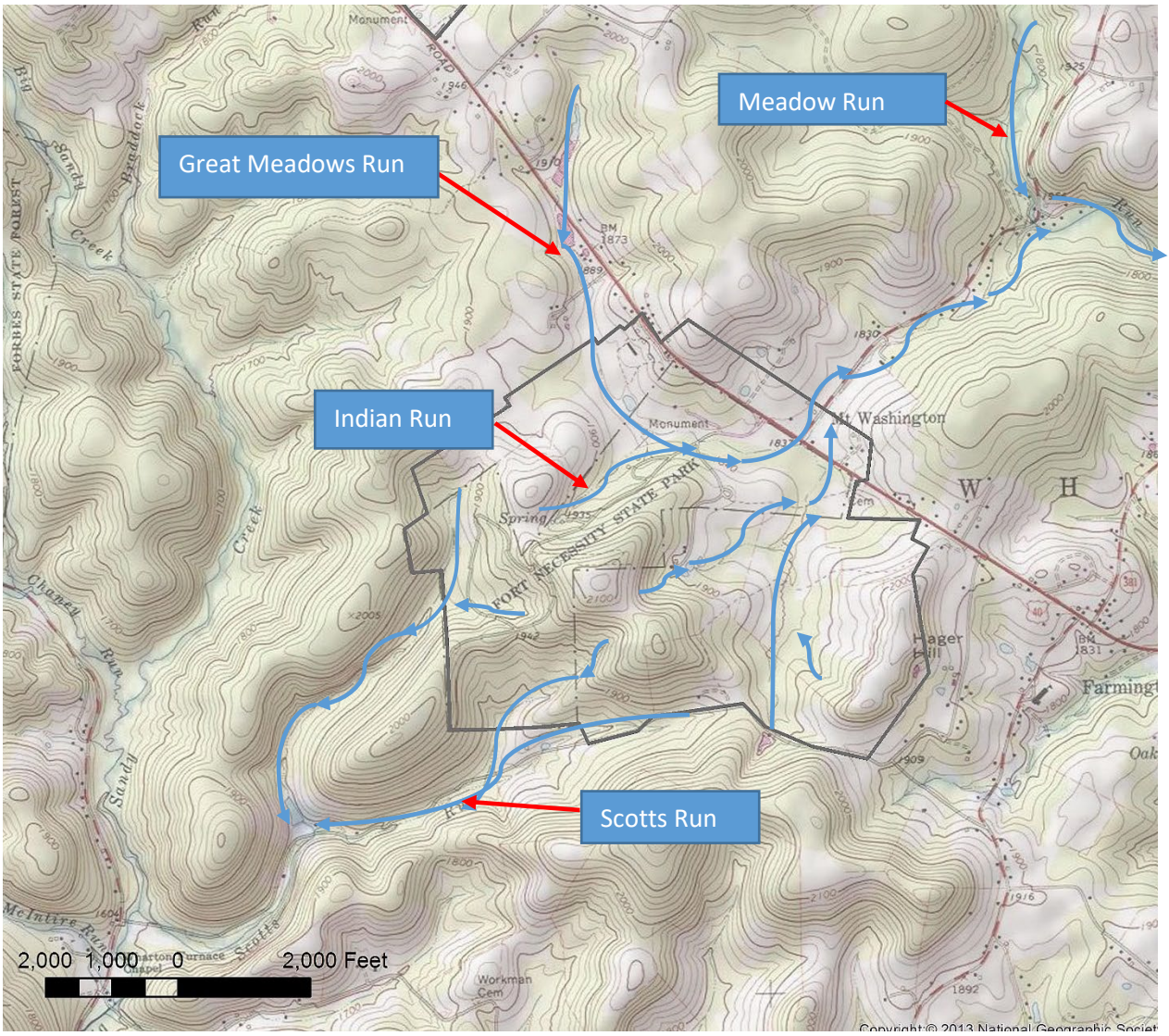
8. CERTIFICATION

I certify that ALL of the project information contained in this receipt (including project location, project size/configuration, project type, answers to questions) is true, accurate and complete. In addition, if the project type, location, size or configuration changes, or if the answers to any questions that were asked during this online review change, I agree to re-do the online environmental review.

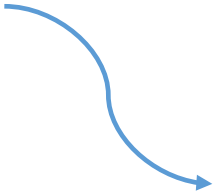
_____ _____
applicant/project proponent signature date

APPENDIX IV. WATER RESOURCES

Fort Necessity Main Unit



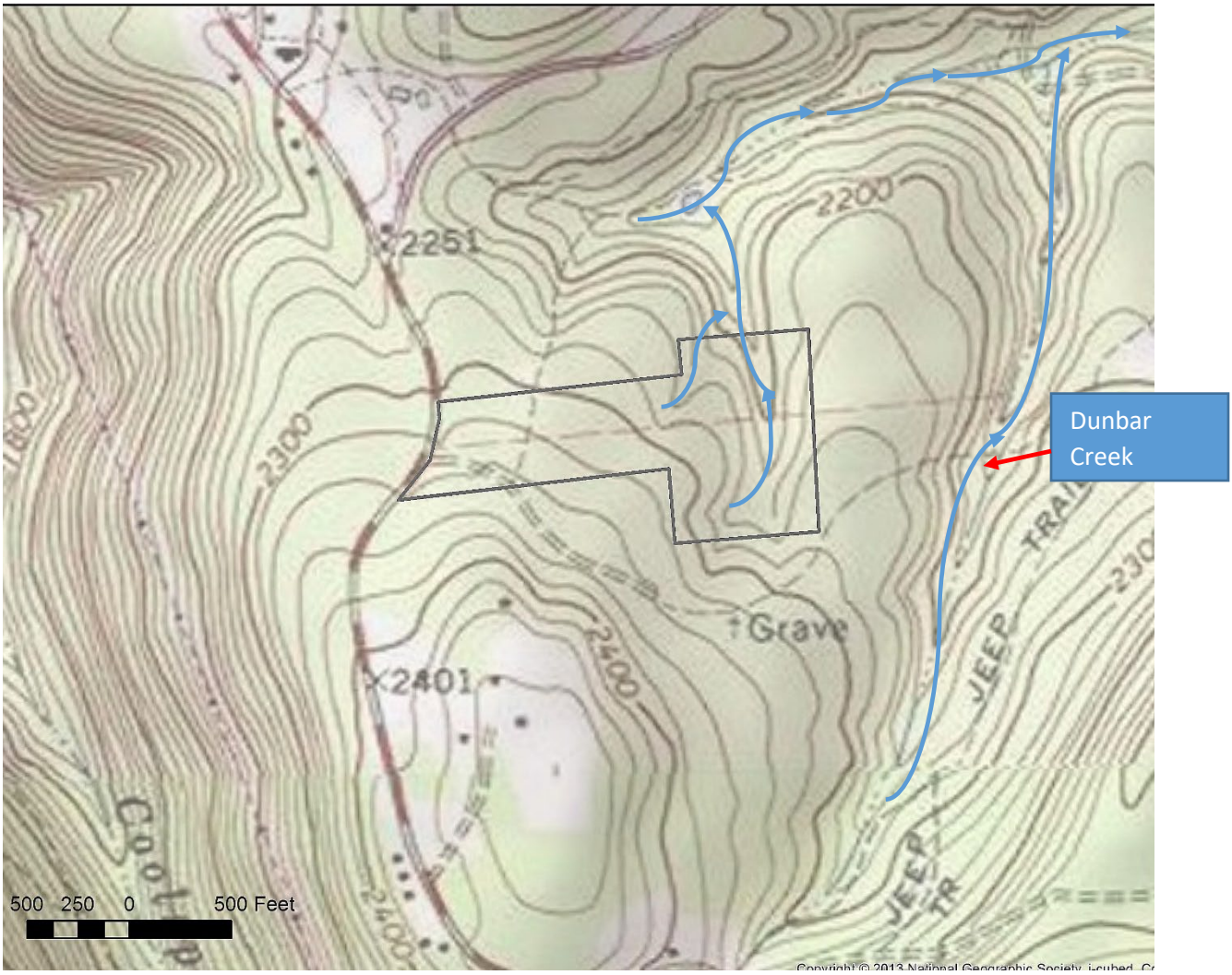
Stream direction



Braddock's Grave

Stream direction

Jumonville Glen



Stream direction:

LITERATURE CITED

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GLOSSARY OF TERMS

ADVANCE REGENERATION: Seedlings or saplings that are present in the understory prior to removal of any overstory.

AGE CLASS: A group of trees in a stand that are at or nearly the same age.

ARTIFICIAL REGENERATION (reproduction): Creation of a new age class by direct seedling or by planting seedlings or cuttings.

BASAL AREA: Total area of cross section of stems measured at breast height (4½ feet above the ground), usually expressed in square feet per acre.

CLEAR-CUT: An even-age method of regenerating a stand through the removal, in a single cut, of all trees larger than seedlings. The new age class develops in a fully exposed microclimate. In some situations, small numbers of trees may be left within the clear-cut opening for some special purpose.

CLIMAX FOREST: The final stage of succession that is relatively stable and self-perpetuating.

COMPETITION: The constant demand of each organism for more growing space, light, nutrients, and water.

COMPOSITION, STAND: The proportion of each tree species in a stand expressed as a percentage of either the total number of stems, basal area, or volume of all tree species in the stand.

CROP TREE: Any tree that is selected to become a component of a future final harvest.

CROP TREE RELEASE: Is a silvicultural technique used to enhance the health and productivity of individual trees, while improving other resources such as wildlife habitat, recreation, timber value, and aesthetics.

CROWN CLASS: A class of tree based on crown position relative to crowns of adjacent trees.

- **Dominant:** Trees with crowns extending above the general level of the main canopy of groups of trees.
- **Codominant:** Trees with crowns forming the general level of the main canopy in groups of trees, receiving full light from above and comparatively little from the sides.
- **Intermediate:** Trees with crowns extending into the lower portion of the main canopy of groups of trees, but shorter in height than the codominants. They receive little direct light from above and none from the sides.
- **Overtopped (Suppressed):** Trees of varying levels of vigor that have their crowns completely covered by the crowns of one or more neighboring trees. These trees receive little, if any, direct light.

DIAMETER CLASS: A group of trees or logs of similar sizes at a common point. Usually in 2-inch increments at d.b.h. for trees and 1-inch increments, inside the bark, on the small end for logs.

EVEN-AGED STAND: A stand of trees containing a single age class in which the range of tree ages is usually less than 20 percent of rotation.

FOREST HEALTH: Forest can be considered healthy when there is a balance between growth and mortality and the forest has the resiliency to react and overcome various forest impacts. Potential forest stressors include insects, pathogens, weather, climate, pollution, and others.

FOREST TYPE: Similarity of composition and development (as in two or more stands of trees) due to the impact of corresponding physical and biological factors; sometimes a forest association.

GROUP SELECTION: A method of regenerating uneven-aged stands in which trees are removed, and new age classes are established, in small groups. The maximum width of the group is approximately twice the height of the mature trees, with these small openings providing micro environments suitable to regenerate shade-intolerant tree species (requiring direct sunlight for growth). These areas are generally not more than ¼ acre in size.

INTERMITTENT STREAMS: Any water course that carries a visible flow of water periodically, usually depending on the season of the year, or the current and recent weather condition.

NATURAL REGENERATION: A stand of trees created from natural seeding, sprouting, securing, or layering.

OLD-GROWTH FOREST: Forests that contain a wide range of tree sizes and ages; a deep, multilayered crown canopy; diverse shrub and forb layers; and significant accumulations of coarse woody debris including snags and fallen logs. Stands typically appear all-aged rather than even-aged. Large trees can be evidence that the old growth ecosystem has had sufficient time to develop diverse structure, although not all old growth stands have large trees, particularly on less productive sites. Large trees can exist in relatively young stands on very productive sites.

OPEN BURNING: Defined as the ignition and subsequent burning of any combustible material (garbage, leaves, grass, twigs, litter, paper, vegetative matter involved with land clearing, or any sort of debris) out-of-doors either in a burn barrel or on the ground. The use of propane or gas stoves, charcoal briquette grills, or the use of tobacco in any form is not covered under county burn bans. Camp fires are allowed in the fire rings that confine and contain the camp fire in a designated State, Federal, or Department of Environmental Protection licensed campground.

PERENNIAL STREAMS: Any stream channel containing a visible volume of water throughout the year with the exception of drought periods.

PINE STAND: Any forest stand whose composition, based on number of stems, volume, or basal area, consists of a majority of pine species (trees with needles in bundles).

PRECOMMERCIAL THINNING: A thinning that does not yield trees of commercial value, usually designed to improve crop spacing.

PRESCRIPTIONS: The written instructions by a forester for the preparation and administration of a resource management practice.

RIPARIAN ZONE: The immediate area influenced by the presence of a concentration of water. The banks of streams, lakes or marshes.

SALVAGE CUTTING: The removal of dead trees or trees being damaged or killed by injurious agents other than competition, to recover value that would otherwise be lost.

SHELTERWOOD METHOD: A method of regenerating an even-aged stand in which a new age class develops beneath the partially-shaded micro-environment provided by the residual trees. In one or more succeeding harvests the residual stand is removed to release the established regeneration.

SILVICULTURE: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

SILVICULTURE SYSTEM: A planned process whereby a stand is tended, harvested, and reestablished. The system name is based on the number of age classes and/or the regeneration method used.

SINGLE TREE SELECTION: A method of creating new age classes in uneven-aged stands in which individual trees of all size classes are removed more or less uniformly throughout the stand to achieve desired stand structural characteristics.

SITE CLASS: A classification of site quality, usually expressed in terms of ranges of dominant tree height at a given age or potential mean annual increment at culmination.

SITE QUALITY (Productivity): The productive capacity of a site, usually expressed as volume production of a given species.

SITE PREPARATION: Reduction of competing vegetation, the removal of physical obstacles to planting and the drainage of water toward or away from the planted trees - to insure successful establishment of new trees.

SITES: Areas considered by ecological factors with reference to capacity to produce forests or other vegetation; the combination of biotic, climatic, and soil conditions of an area.

SIZE CLASSES: Tree sizes recognized by distinct ranges, usually of diameter or height.

STAND: A contiguous group of trees sufficiently uniform in age class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.

- **Mixed Stand** - A stand in which there is a mixture of species.
- **Pure Stand** - A stand composed of essentially a single species.
- **Stratified Mixture** - A stand in which different species occupy different strata of the total crown canopy.

STOCKING: An indication of growing-space occupancy relative to a pre-established standard. Common indices of stocking are based on percent occupancy, basal area, relative density and crown competition factor.

STREAM ORDER: Stream order is a measure of the relative size of streams. The smallest tributaries are referred to as first-order streams, while the largest river in the world, the Amazon, is a twelfth-order waterway. First- through third-order streams are called headwater streams.

SUCCESSION (ecological): A process of community development that involves changes in species structure and community processes over time.

SUCCESSIONAL STAGE: One in a series of usually transitory communities or developmental stages that occur on a particular site or area over a period of time. Eventually, on most sites, a relatively stable, self-perpetuating stage, called a climax, is attained.

SUSTAINABLE: To produce a steady predictable quantity of all resources over time.

THINNING: A cutting made to reduce stand density of trees primarily to improve growth, enhance forest health, or to recover potential mortality.

TOLERANCE, SHADE: The relative capacity of a plant to become established and grow in the shade.

TREE OF CONCERN: Pertains to any potential tree failure due to a structural defect that may result in property damage or personal injury.

TREE SHELTERS: A translucent plastic tube supported by a stake, placed around tree seedlings. Shelters protect seedlings from deer and small mammal damage and extremes in environmental conditions, thereby boosting the seedlings chances of survival and usually enhancing the growth rate.

UNEVEN-AGED STAND: A stand of trees of three or more distinct age classes, either intimately mixed or in small groups, separated in age by more than 20 percent of the rotation.

UNDERSTOCKED: A stand with any combination of basal area and stems per acre insufficient to optimally utilize the available growing space by the trees present.

WETLANDS: Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered with shallow and sometimes temporary waters, at least part of the year.

USDA United States Department of Agriculture | Forest Service | Northeastern Area State and Private Forestry | 180 Canfield Street Morgantown, WV 26505-3101

File Code: 3410
Date: October 9, 2017

Stephen M. Clark, Superintendent
National Park Service / Western Pennsylvania Parks
c/o Flight 93 National Memorial
P.O. Box 911 Shanksville, PA 15560

Dear Mr. Clark,

Enclosed is a copy of the Forest Health Assessment and Biological Evaluation of the Fort Necessity Battlefield. To develop this plan, Forest Health and Forest Management personnel from the USDA Forest Service Field Office in Morgantown (MFO) performed a reconnaissance and collected data within all 3 units that make up the Park. The purpose of this document was to help the MFO to evaluate the current forest resources in the Park, identify potential pests of concern, and make recommendations to protect and enhance the forest resources. The development of this document has resulted in a strengthened partnership between the National Park Service and the USDA Forest Service. None of this would have been possible without the support and contributions from MaryEllen Snyder, Casey Reese, Stephanie Perles, and Doug Manning.

If you or any of your staff have any questions or comments regarding this assessment, please contact Karen Sykes at (304) 285-1532 or Amy Hill at (304) 285-1565.

Sincerely,

Richard Turcotte
Acting Field Representative
USDA Forest Service
Forest Health Protection

Cc: Casey Reese